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DETERMINATION OF INSERTION LOSS AND EVALUATION OF TRAFFIC NOISE BARRIER DESIGN METHOD

ROUTE 444 (GARDEN STATE PARKWAY)

BY
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16. Abstract

Traffic noise data was collected at four sites adjacent to the Garden State Parkway (Rt. 444) in Woodbridge and Clark Townships. Three of these sites had concrete post-and-panel noise barriers; the fourth was a control site having no barrier. Traffic counts and radar speed readings were recorded simultaneous with the collection of the noise data. For all sites, data collection took place before and after barrier construction, with the noise sample sizes ranging from 19 to 125 useable observations. Barrier sites had a reference microphone placed at the barrier and set five feet higher than the particular barrier top. Two field microphones were placed along a line perpendicular to the highway, five feet above ground level. The same configuration was used at the control site, except that the reference microphone was always set at fifteen feet above ground level.

Analysis of the noise data by non-parametric statistical methods showed that insertion losses resulting from barrier construction were virtually nonexistent. In addition, STAMINA 2.0, the design method currently in use at NJDOT was tested using the same statistical technique. Although the accuracy of this model has been verified for a variety of conditions throughout the country, it did not accurately predict noise levels for either the "before" or "after" condition and therefore could not have been used to determine the effectiveness of the barriers. It is possible that the mix of 99+% light vehicles for this highway is beyond the capabilities of this model.

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TABLE OF CONTENTS

PAGE

Summary and Conclusions 1

Recommendations 4

Introduction 6

Study Procedures 7

Data Collection 7

Data Reduction 18

Data Analysis 20

Model Verification 23

Results and Discussion 24

Data Analysis 24

Model Verification 31

References 36

Appendix I 37

Data Collection Procedure 37

Major Items of Data Collection Equipment 39

Appendix II 42

Data Reduction Procedure 42

Major Items of Data Reduction Equipment 44

Explanation of Column Headings-Appendices III-IX 46

Appendix III: Noise and Traffic Data-East Iselin Parkway 47

Appendix IV: Noise and Traffic Data-East Louis Place 49

Appendix V: Noise and Traffic Data-Willow Street 1 51

Appendix VI: Noise and Traffic Data-Willow Street 2 54

TABLE OF CONTENTS-continued

PAGE

Appendix VII: Noise and Traffic Data-Control Site 57

Appendix VIII: Noise and Traffic Data-Willow Street 1: Before Barrier Construction 60

Appendix IX: Noise and Traffic Data-Willow Street 2: Before Barrier Construction 61

LIST OF FIGURES AND TABLES

PAGE

Figure 1: East Iselin Parkway - Microphone Positions 9

Figure 2: East Iselin Parkway - Microphone Elevations 10

Figure 3: East Louis Place - Microphone Positions 11

Figure 4: East Louis Place - Microphone Elevations 12

Figure 5: Willow Street - Microphone Positions 13

Figure 6: Willow Street 1 and 2 - Microphone Elevations 14

Figure 7: Control Site - Microphone Positions 15

Figure 8: Control Site - Microphone Elevations 16

Figure 9: Effect of Barrier on L_2 P_2 29

Figure 10: Typical Van and Microphone Positioning 40

Figure 11: Data Collection Equipment Layout 41

Figure 12: Data Reduction Equipment Layout 45

Table I: Microphone Position Designations 8

Table IA: Site Designations 8

Table II: Number of Useable Observations Obtained from Data Reduction Process 19

Table III: Median L_{eq}'s from Full Sample in dBA 21

Table IV: Insertion Losses with 95% Confidence Limits for Samples in dB 25

Table V: Median Traffic Counts and Speeds Per Five Minute Observation 27

Table VI: Before and After Barrier Construction Differences Between Median L_{eq}'s for References and Field Microphones 28

Table VII: Comparison of Insertion Losses and 95% Confidence Limits in dB 32

Table VIII: Comparison of Sample Sizes 33

Table IX: Comparison of Median L_{eq}'s for Each Type of Sample Considered 34

LIST OF FIGURES AND TABLES

PAGE

SUMMARY AND CONCLUSIONS

Traffic noise data was collected at four sites adjacent to Route 444 in Woodbridge and Clark Townships to determine the insertion losses of prestressed concrete post and panel barriers erected at these sites, and to assess the accuracy of the current design model used at NJDOT. Two of the barrier sites and the one control site were on the northbound side; the remaining barrier site was on the southbound side. In addition to the noise data, traffic counts were kept for traffic on both sides of the highway, and radar speed readings were recorded for traffic on the same side as the particular site.

Each site had three microphone locations. The Reference location was at the barrier, at a height five feet above the top of the particular barrier to eliminate any interference. At the Control Site the Reference location was 80 feet from the edge of the near lane, this location being dictated by the physical limitations of the site. At all sites the field microphones were placed 50 and 100 feet behind the Reference microphone, along a line perpendicular to the roadway. At the Willow Street site, field microphones were mounted at five and fifteen-foot heights, the upper microphones being placed in order to gain some knowledge of possible barrier diffraction. At all other sites the field microphones were placed at five-foot heights. See Figures 1 - 8, pages 9 - 16, for diagrams of microphone positions.

Data was collected for both the before and after barrier construction conditions. The "before" study was conducted prior to the reconstruction of the roadway; the "after" study was conducted after the roadway was widened from three lanes to four, and resurfaced with bituminous concrete. Field observations were six minutes long, later edited to five minutes in the laboratory to eliminate non-highway noise, and the resulting "clean" portions were reduced to yield an L_{eq} for a total of five minutes of traffic noise. The end product of the data reduction was two sets of observations at

each site, one made before barrier construction (with the original portland cement concrete pavement) and the other made after barrier construction (after widening and resurfacing).

All data sets were tested for normality, the result being that only about half could be accepted as such. The data was therefore analyzed using nonparametric methods to obtain the insertion losses and their associated confidence limits. This technique was based on taking the difference in medians between the "before" and "after" Reference data for each site, subtracting this difference from the "before" and "after" differences for each of the field microphones at the site, which yielded one figure for each microphone, which was taken as the first estimate of insertion loss. This was refined to obtain a "best fit" with 95% confidence limits for each case. The technique is described in detail in the section on study procedures.

As can be seen from Table IV, page 25, the insertion losses are virtually non-existent, the far greater portion of the noise reduction being due to the reconstruction of the highway. It may therefore be concluded that the barriers at the sites studied are of no value in reducing traffic noise.

To expedite the assessment of STAMINA 2.0, the design model now in use at the New Jersey Department of Transportation, small samples of up to size 15 were randomly selected from the full sample of traffic counts from each microphone, for both the "before" and "after" conditions. An L_{eq} was predicted for each of the traffic counts selected using STAMINA 2.0, and these in turn were used to determine insertion losses by the same non-parametric method as was used for the full samples of "measured" L_{eq}'s. As a control, analogous small samples of "measured" L_{eq}'s were also used to calculate insertion losses by this method. The two sets of small-sample results (for both R and insertion losses) were compared with each other and it was found that the results using the predicted levels bore no resemblance to those obtained from the field measurements. The predicted levels were also compared to the full-

sample "measured" results and shown to be completely different in this instance as well. Last, the short-sample "measured" results were compared to those from the full-size samples. These were recognizeably close to the full-sample results, but not close enough to be acceptable substitutes, especially since the confidence limits were rather broad. Table VII, page 32, shows the results determined from the three sets of samples.

Three conclusions were drawn from the preceding information. First, samples of size 15 or smaller will not yield acceptably accurate determinations of insertion losses, even for a highway which is used almost exclusively by passenger cars. Second, STAMINA 2.0 cannot be used to accurately predict L_{eq}'s for either the "before" or "after" conditions of this study, irrespective of sample size. Third, STAMINA 2.0 did not yield L_{eq}'s which could be used to accurately determine the change in median levels from "before" to "after," and so could not have been used to determine insertion losses.

This is not to say that STAMINA 2.0 is not a valid model, especially since it has been verified numerous times in various locales, including the I-676 portion of this project. However, it must be emphasized that it did not predict accurately for the conditions found on Route 444.

RECOMMENDATIONS

The extremely poor barrier performance on Route 444 is apparently due to barrier placement more than anything else. The fact that the barriers are 88-90 feet from the edge of the near lane at the test sites places them much too far from the source to be effective. Furthermore, two of the three barriers studied were placed in depressions, so that their effective height was greatly reduced. However, this appears to be rather less critical than distance from the source, since the Willow Street barrier was slightly elevated, but proved to be as ineffective as the others. (See Figures 1 - 8, pages 9 - 16). It is therefore recommended that future barriers be placed as close to the roadway as is practical from an engineering standpoint, and that they also be elevated if possible, but under no circumstances be placed in depressions unless the height of the structure is increased to compensate for this condition.

It is also recommended that STAMINA 2.0 be calibrated for those situations where light vehicles are to be the major source of noise. While Route 444 is a case in point, it should be noted that in many areas nationwide rush hour traffic is almost totally made up of passenger vehicles. It is therefore reasonable to recommend that STAMINA 2.0 be permanently modified to accurately predict noise for this condition.

In the longer view, research should be conducted to determine the effect that changes in riding surface due to reconstruction have on traffic noise, so that STAMINA 2.0 can be modified to predict with increased accuracy. It is apparent from this study that this effect is considerable and should certainly be considered as an important factor in any design model.

Last, it is recommended that for situations where light vehicles are the major source of traffic noise, samples of 30 - 40 useable observations of 6-minute duration (unedited) be obtained. This observation length will take into account both platoons and indivdual vehicles, and when samples are collected over a period of several days

will contain the longer-term variations in traffic noise. Thus accuracy will be preserved without having to resort to the very large samples collected in some portions of this study.

INTRODUCTION

The primary objectives of the Route 444 portion of this project were to determine the insertion losses of the barriers at the locations studied, and to determine the accuracy of the existing design model. The original plan to construct noise barriers at various locations as part of the reconstruction of this highway provided an ideal situation for obtaining "before" and "after" noise data to be used in meeting these objectives. Accordingly noise and traffic data were collected during the summer and fall of 1976 at six sites where barriers were suppoesd to be constructed as well as at a control site, where no barrier was to be built. After the data had been collected and reduced however, it was decided that barriers would not be built at four of the sites. In order to obtain as much information on insertion losses as possible, it was decided to try to find a third barrier site with the result that in the summer of 1978 the "before" study was resumed, at the Willow Street site. At this time data was obtained from field microphones placed at a fifteen-foot height as well as at the usual five-foot height, to try to obtain additional information about barrier diffraction.

In the summer of 1981, as soon as possible after the completion of the barriers, the "after" study was begun. Data collection for those sites with barriers was completed during that summer and data collection at the Control Site was completed in the spring of 1982. Appendices III - IX, pages 47 - 61, contain the "after" data from each site, and the "before" data from the Willow Street site.

The barriers were constructed of posts and panels of prestressed concrete, set on variable centers according to the requirements of the terrain. The panels are 2 feet high by 4 inches thick, with a sponge rubber joint filler between panels which is compressed into a tight seal by the weight of the panel. In some locations the bottom panel has an 18-inch drainage opening at ground level. The total installation comprises 5800 linear feet, constructed at a bid price of $348,000. However, the actual construction cost was substantially higher.

STUDY PROCEDURES

DATA COLLECTION

Data collection was designed to yield traffic noise data, traffic counts, and traffic speeds for both before and after barrier construction at three barrier sites and a control site where no barrier was built. All sites had a 40 to 60-foot mowed grass median, at virtually the same grade as the roadways. There were no vertical curbs or center barriers at any site, nor any noise barriers opposite those evaluated. Even if there had been noise barriers opposite it is doubtful whether they would have had any effect, since in every case they would have been at least 350 feet from the barrier being tested.

Microphones were located at the barrier line (Reference), 50 feet behind the barrier along a line perpendicular to the Route 444 roadway (Location 1), and 100 feet behind the barrier, also along a line perpendicular to Route 444 (Location 2). At sites having barriers the Reference microphone was placed five feet higher than the top of the barrier, which varied according to location. The field microphones at Locations 1 and 2 were placed five feet above street pavement level. At the Control Site the Reference microphone was set 15 feet above ground level, with the field microphones set at five feet above ground level. At Willow Street the field microphones were placed at both 5 and 15 feet above pavement level, at both locations. See Figures 1 - 8, pages 9 - 16, for diagrams of microphone placement. At sites with three microphones, traffic noise was recorded from all three simultaneously. At Willow Street, noise was recorded from the Reference - Location 1 combination, and then from the Reference - Location 2 combination, on different days.

Tables I and IA following indicates the abbreviated designations for the various microphone positions and the various test sites, to be used for the remainder of this report.

TABLE I

MICROPHONE POSITION DESIGNATIONS

POSITION	HEIGHT	DESIGNATION
Reference	13 ft. or 15 ft., depending upon site	R
Location 1, Position 1	5 ft.	L1P1
Location 1, Position 2*	15 ft.	L1P2*
Location 2, Position 1	5 ft.	L2P1
Location 2, Position 2*	15 ft.	L2P2*

*Used at Willow Street only

TABLE IA

SITE DESIGNATIONS

SITE	NEAR SIDE TRAFFIC DIRECTION	DESIGNATION
East Iselin Parkway	Northbound	EIP
East Louis Place	Northbound	ELP
Willow St.:R-L1P1, L1P2 Combination	Southbound	WS-1
Willow St.:R-L2P1, L2P2 Combination	Southbound	WS-2
Control Site: Milepost 137	Northbound	CON

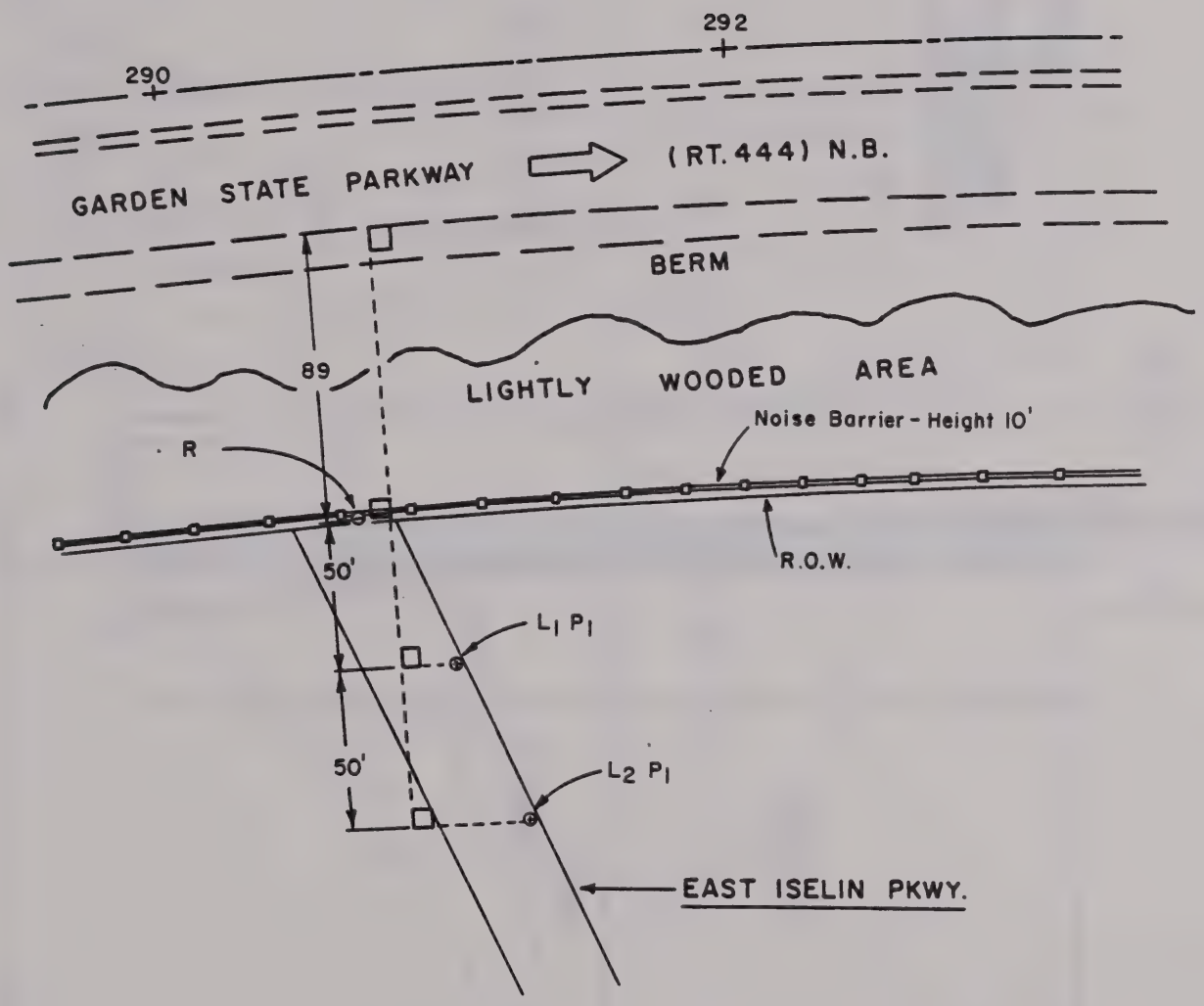


FIGURE 1

EAST ISELIN PARKWAY - MICROPHONE POSITIONS

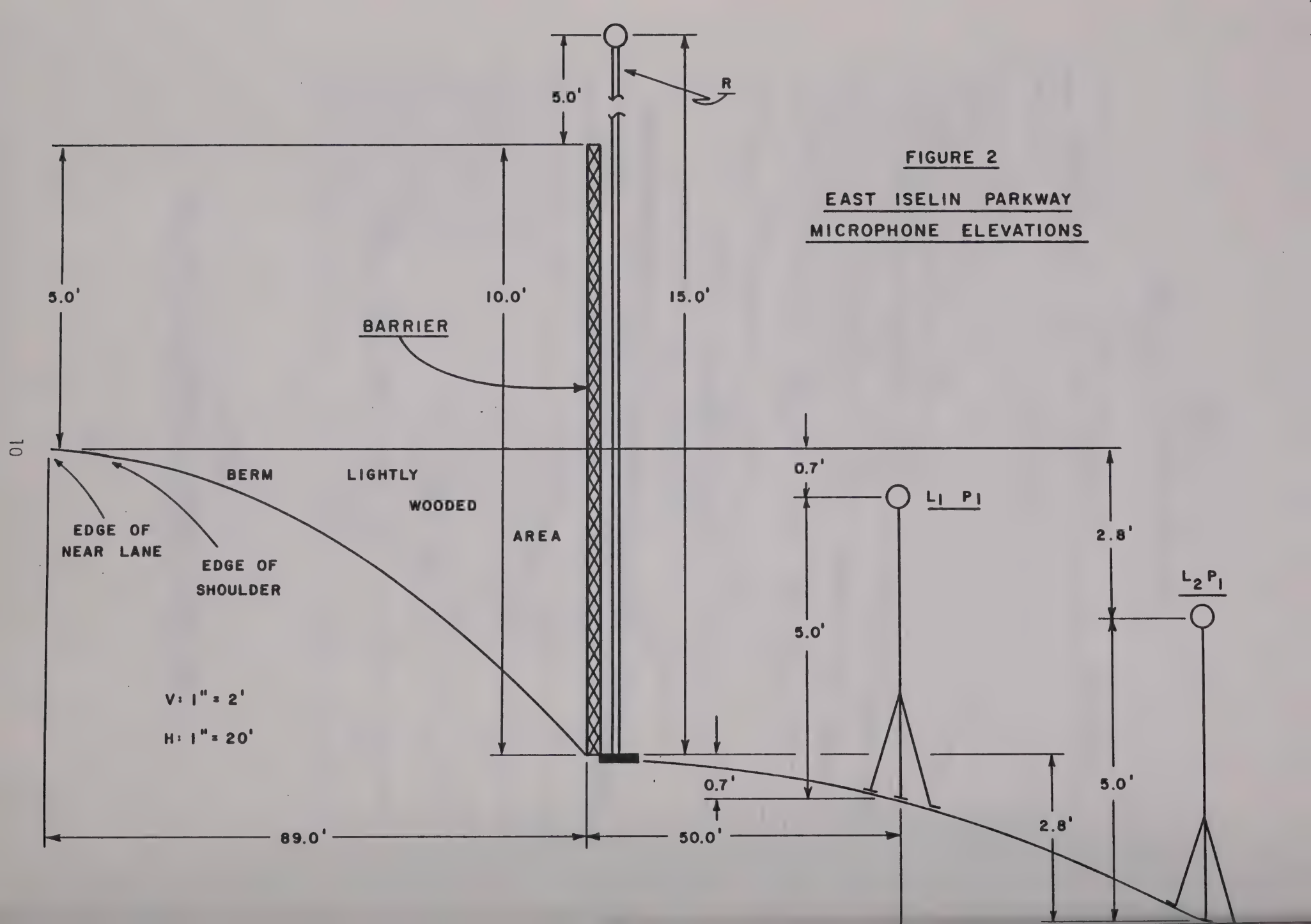


FIGURE 2

EAST ISELIN PARKWAY

MICROPHONE ELEVATIONS

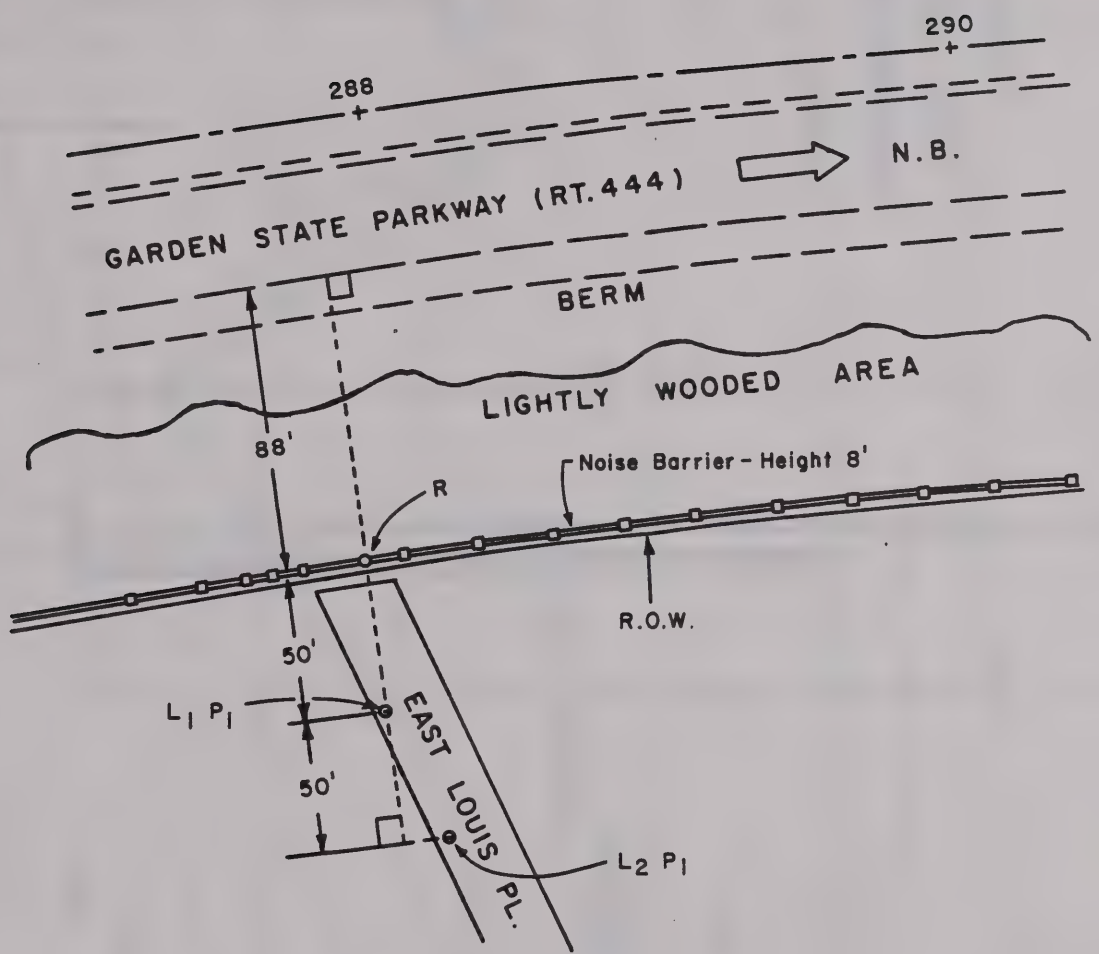


FIGURE 3

EAST LOUIS PL. - MICROPHONE POSITIONS

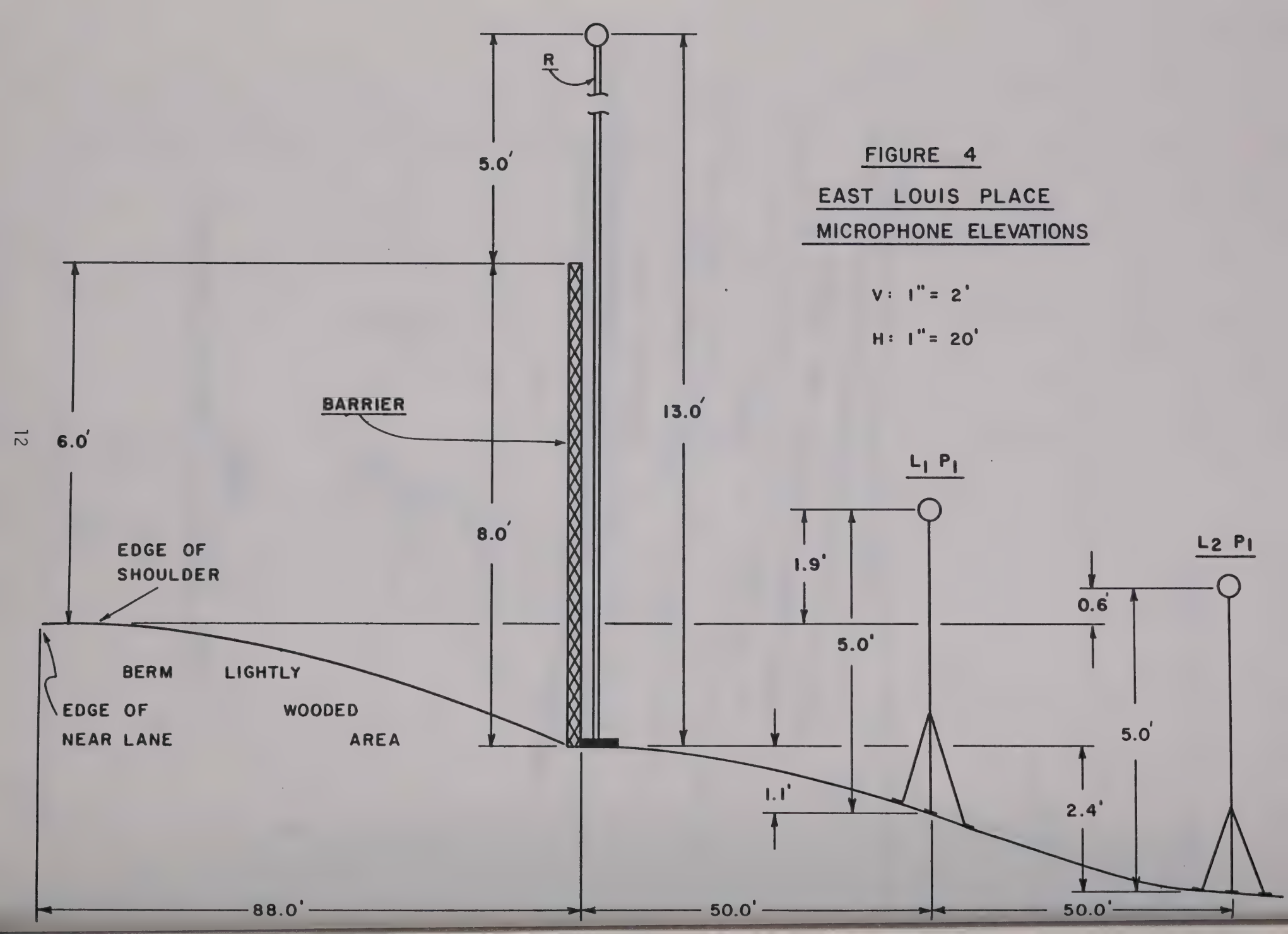


FIGURE 4

EAST LOUIS PLACE

MICROPHONE ELEVATIONS

V: 1" = 2'

H: 1" = 20'

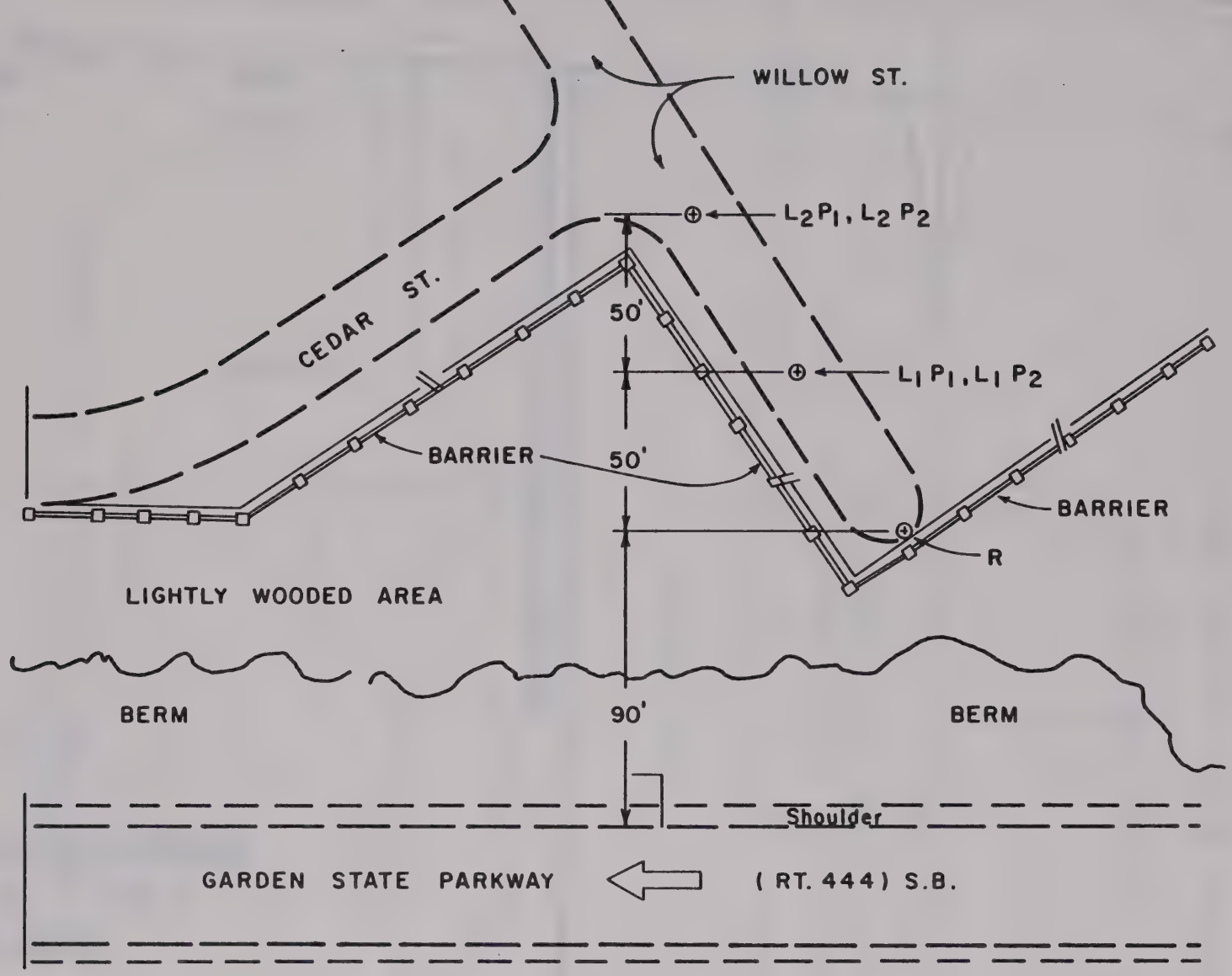


FIGURE 5

WILLOW STREET – MICROPHONE POSITIONS

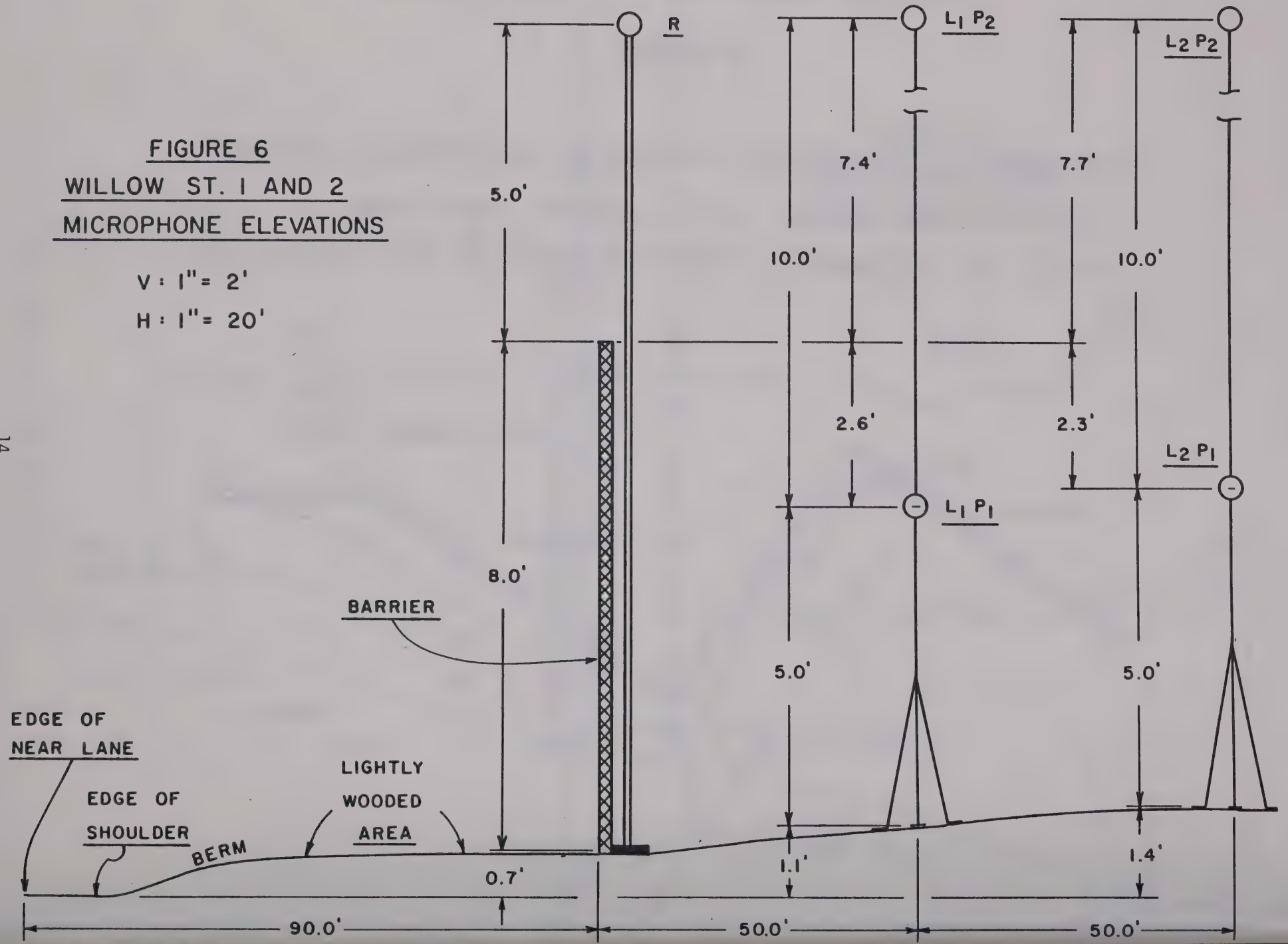
FIGURE 6

WILLOW ST. 1 AND 2

MICROPHONE ELEVATIONS

V : 1" = 2'

H : 1" = 20'



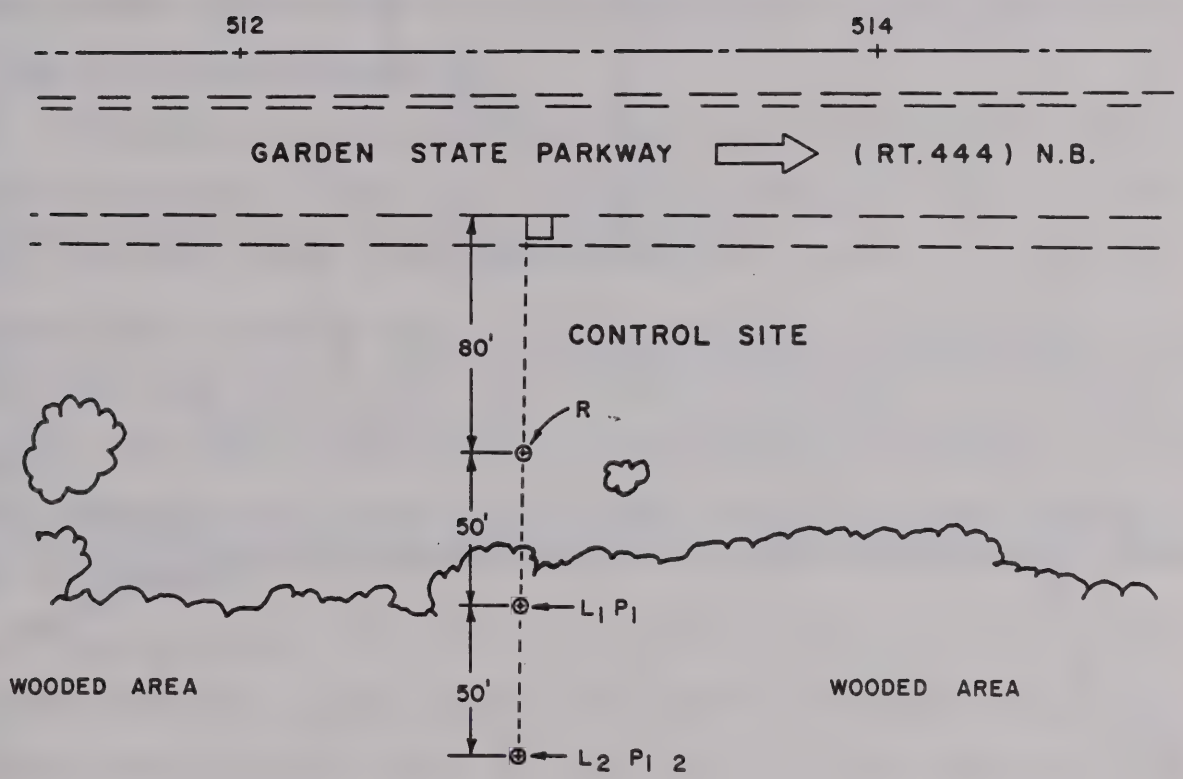


FIGURE 7

CONTROL SITE - MICROPHONE POSITIONS

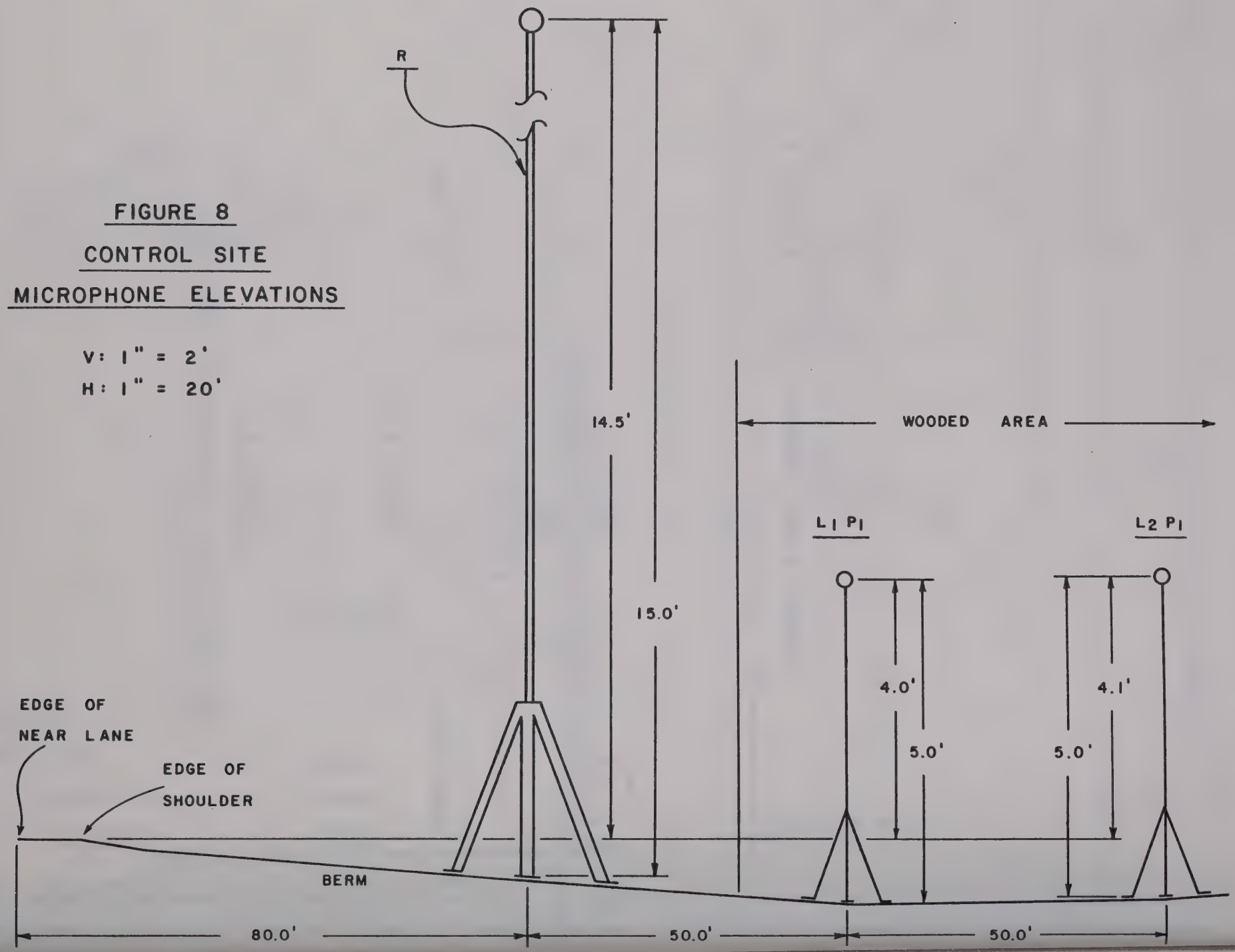
FIGURE 8

CONTROL SITE

MICROPHONE ELEVATIONS

V: 1" = 2'

H: 1" = 20'



Complete traffic counts were made for the duration of each traffic noise observation. These were categorized by northbound and southbound vehicles, and further subdivided into light vehicles, medium trucks, and heavy trucks. Also at this time a minimum of ten radar speed readings were recorded for traffic on the roadway adjacent to the microphones. Wind speed and temperature were also recorded about every twenty minutes, primarily to determine the feasibility of continuing recording under doubtful weather conditions. No data was collected when wind speed exceeded 10 mph or when the roadway was wet.

All equipment was battery-powered to eliminate generator noise. However, previous experience in traffic noise sampling in metropolitan New Jersey had shown that noise from aircraft, locally operated trucks and equipment, and from other sources resulted in approximately 25% of the obervations being discarded and a like percentage being heavily edited. It was therefore decided at the start of the "after" portion of the data collection to try to obtain at least 100 observations for each microphone at each site in order to insure having at least 50 usable observations once the data was reduced.

Observations were of six-minute duration nominally, to be later shortened to five minutes during data reduction. Detailed field notes were kept concerning extraneous noise in order to facilitate editing. See Appendix I for a complete description of the data collection process, field equipment layout, and a list of major equipment items used in data collection.

Recording tapes were nominally 45 minutes long. This allowed time for seven six-minute observations on each channel simultaneously, while leaving adequate room for calibration signals, voice announcements, an extra-long observations when there was prolonged interference from non-highway noise.

DATA REDUCTION

Data reduction served two purposes. The first was to edit out the non-highway noise from each observation; the second was to obtain an L_{eq} for each of the edited observations. This work was accomplished using the equipment listed in Appendix II, page 42. Also in Appendix II are a diagram of the equipment layout for data reduction, and a complete description of the data reduction routine.

Only one channel could be reduced at a time and in general, each channel had to be played back twice. The first run was to check the calibration signals at the beginning and end of each channel; the voice announcements at the beginning, end, and between observations; and most important - which portions of each observations were to be edited out so that a "clean" sample of five minutes of traffic noise could be obtained.

Central to obtaining and recording all of this information was the graph produced by the 2305 Bruel and Kjaer Graphic Level Recorder. Information coming over the monitor speaker (calibration signal, traffic and non-traffic noise, voice announcements) was noted on the graph as it was produced continuously by the machine. Since the graph paper was fed at a known set speed, the graph could be used as a timing index for the second run-though of the same observation, at which time the extraneous noise was edited out and (ideally) seven observations of the desired length were obtained from the tape. During this second playback the traffic noise was A-weighted and an L_{eq} obtained for each five minutes of "clean" noise.

As expected, a large number of the observations were so contaminated with non-highway noise that they could not be edited and were therefore discarded. Table II, page 19, lists the number of usable observations for each microphone position for both the "before" and "after" conditions.

As can be seen from this table, the goal of 50 observations was not always realized, primarily due to contamination by extraneous noise.

TABLE II

NUMBER OF USEABLE OBSERVATIONS OBTAINED

FROM DATA REDUCTION PROCESS

SITE		MICROPHONE POSITION				
		REFERENCE	LOCATION 1 POSITION 1	LOCATION 2 POSITION 1	LOCATION 1 POSITION 2*	LOCATION 2 POSITION 2*
East Iselin Parkway	B	55	28	27	---	---
	A	104	68	52	---	---
East Louis Place	B	44	19	25	---	---
	A	82	58	36	---	---
Willow St.: R-L1P1, L1P2	B	33	28	---	34	---
	A	104	88	---	95	---
Willow St.: R-L2P1, L2P2	B	28	---	43	---	28
	A	93	---	63	---	87
Control Site	B	65	40	25	---	---
	A	125	118	111	---	---

*Used at Willow Street only
B - Before Barrier Construction
A - After Barrier Construction

Also included in data reduction was the preparation of traffic data, which was accomplished after the noise data had been reduced. As already explained, much of the noise data was discarded because of contamination by non-highway noise, so that as a first step in reducing the traffic data it was necesasry to be certain that an L_{eq} for a particular five-minute observation had been obtained for at least one of the microphone positions for which noise had been recorded simultaneously during data collection (e.g.: R, L1P1, L1P2). For those observations meeting this criterion, an average speed was determined from the 10 or more radar readings taken during the original (six-minute) observation, and the traffic counts were reduced proportionately to agree with the five-minute (edited) noise observation. Appendices III - VII, pages 47 - 59, contain the reduced noise and traffic data.

DATA ANALYSIS

The fundamental purpose of the data analysis was to determine barrier insertion losses, with confidence limits, at the 95% confidence level. Based on the experience gained during the data analysis for a previous study conducted on I-280,[1] it was decided to apply the Wilcoxon rank-sum test if any of the data sets proved to be from non-normal distributions. Accordingly each set was tested and approximately half of them were shown to be distributed non-normally. The next step was to construct histograms for each pair of data sets (e.g.: R "before" and R "after") so that it could be determined if it was feasible to test the data sets to see if they were from the same population. In most cases the histrograms showed that the distributions appeared to be the same except that they differed by a constant, which was close to the difference in medians between the two sets. This was also true for those pairs of histograms in which the distributions appeared to be different.

---

[1] Reference (3)

TABLE III

MEDIAN Leq'S FROM FULL SAMPLE IN dBA

SITE		MICROPHONE POSITION				
		REFERENCE	LOCATION 1 POSITION 1	LOCATION 2 POSITION 1	LOCATION 1 POSITION 2*	LOCATION 2 POSITION 2*
East Iselin Parkway	B	77.1	67.5	64.8	---	---
	A	69.2	58.1	57.5	---	---
East Louis Place	B	76.1	65.7	62.8	---	---
	A	68.6	57.4	56.4	---	---
Willow St.: R-L1P1, L1P2	B	77.5	68.4	---	75.0	---
	A	70.5	60.5	---	66.9	---
Willow St.: R-L2P1, L2P2	B	76.8	---	64.0	---	71.5
	A	70.8	---	57.8	---	61.5
Control Site	B	79.8	68.5	64.5	---	---
	A	72.0	62.2	58.9	---	---

*Used at Willow Street only
B - Before Barrier Construction
A - After Barrier Construction

By adding the difference in medians to all of the data from one set, both sets could be shown to be from the same population, using the rank-sum test. This difference was then adjusted by a small amount in some cases to yield the best fit. This "adjusted difference" was then assumed to be the actual difference between the "before" L_{eq}'s and the "after" L_{eq}'s for each microphone at each site. Table III, page 21, shows the median levels for the full samples from all microphones.

It is clear from Table III that the median Reference L_{eq}'s for the "after" portion of the study are much lower than for the corresponding "before" levels. This is discussed in the sequel; for now this fact will merely be used to provide an "adjusted difference" which had nothing to do with the construction of the barrier (since it occurred at R, where the microphone was placed so as to avoid any effect from the barrier). This difference in "before" and "after" median L_{eq}'s at the barrier was subtracted from the "before" and "after" (adjusted) median differences at the particular corresponding field microphones, the remainder being considered the insertion loss at that microphone.

Confidence limits were obtained using a procedure for determining these limits for large samples.[2] The method comprised four steps:

1. Adding the "adjusted difference" from the reference microphone and the insertion loss for each field microphone to each of the "after" L_{eq}'s for that microphone;
2. Forming a table of differences between each "before" and each "after" data point (L_{eq}). If there are m "before" and n "after" points, there are mn differences;
3. Ordering these differences from lowest to highest;

---

[2] Reference (6); pages 78 and 79

4. Using the formula for large sample approximation to determine the integer which locates the confidence limits in the table of ordered differences. For instance, if the integer were 25, the upper and lower confidence limits would be the 25th difference from the lower and upper ends of the difference table.

This method is directly associated with the Wilcoxon rank-rum test.

MODEL VERIFICATION

In order to expedite the determination of the accuracy of L_{eq} prediction using STAMINA 2.0, the current design model at NJDOT, small samples of size 15 were randomly selected from the full samples of traffic counts. Selection was made on the basis of observation number. The L_{eq}'s from STAMINA 2.0 were analyzed by the same method as the full samples obtained from field measurements. For comparison, the same observation numbers were used to obtain analogous small samples of "measured" L_{eq}'s (i.e. L_{eq}'s obtained from the reduction of field data). In some cases, and especially with the "before" data, either the traffic speeds or the "measured" L_{eq}'s were missing for a particular microphone. Thus many of the small samples had fewer than 15 observations for one or more microphone positions. However, this did not affect the accuracy of the analysis results.[3]

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[3] Reference (5), pages 182 and 183

RESULTS AND DISCUSSION

DATA ANALYSIS

Table IV, page 25, gives the insertion losses and 95% confidence limits for all field microphones, as determined from the full sample for each. Included for clarity are the adjusted ("best fit") differences for the reference microphones, as well as those for the Control Site, for which there were no insertion losses. The method of determining insertion losses is explained in the Study Procedures section, pages 20 -22.

The "before" and "after" difference for the Reference microphone at the Control Site is in keeping with those from the other four entries. Applying the rank-sum test to all five differences, we see that there is a greater than 80% chance that the Control Site difference is from the same population as the other four.[4] The fact that the table ends at 80% prevents the determinaton of higher probability, but an examination of the method itself indicates that the probability might be much higher.[5] Furthermore, a test of the "insertion losses" at the Control Site show that they are from the same population as the actual insertion losses determined for the sites with barriers, for microphones placed at the five-foot height. These two facts support a very important conclusion; to wit, that the major portion of noise reduction at the field microphones is due to the reconstruction of the highway, and not due to the construction of noise barriers. This statistically-drawn conclusion is further supported by the physical fact that the overwhelming majority of vehicles on this road are passenger cars, for which tires are the traditionally accepted primary noise generators. Certainly the reconstruction of the highway, which included repaving the 30-year-old portland cement concrete surface with bituminous concrete, would result in a major reduction in traffic noise.

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[4] Reference (6), page 272

[5] ibid, page 68

TABLE IV

INSERTION LOSSES WITH 95% CONFIDENCE LIMITS FOR

SAMPLES - IN dB

SITE	MICROPHONE POSITION				
	REFERENCE*	LOCATION 1 POSITION 1	LOCATION 2 POSITION 1	LOCATION 1 POSITION 2**	LOCATION 2 POSITION 2**
East Iselin Parkway	7.9: +0.2 -0.3	1.2: +0.3 -0.3	-0.5: +0.3 -0.3	---	---
East Louis Place	7.5: +0.4 -0.2	1.0: +0.4 -0.4	-1.0: +0.3 -0.5	---	---
Willow St.: R-L1P1, L1P2 Combination	6.8: +0.2 -0.3	0.9: +0.6 -0.8	---	1.5: +0.5 -0.7	---
Willow St.: R-L2P1, L2P2 Combination	5.9: +0.2 -0.3	---	0.3: +0.5 -0.6	---	4.7: +0.7 -0.7
Control Site***	7.8: +0.2 -0.2	-1.5: +0.3 -0.3	-2.3: +0.8 -0.7	---	---

* Not an insertion loss: this is the difference between the "before" and "after" median levels.

** Used at Willow St. only

*** No barrier at Control Site; these differences were calculated by the same method as used to determine insertion losses.

Negative insertion losses are a result of the computation method and should not be interpreted otherwise.

Also of interest is the fact that the comparatively large difference in "before" and "after" speeds at the Control Site (See Table V, page 27) had virtually no effect on the noise levels.

A further indication of the ineffectiveness of the barriers is the result of an analysis of the R-L1P1 and R-L2P1 differences for the barrier sites shown in Table VI, page 28. The probability that the "before" differences are from the same population as the "after" differences is quite high (about 94%). This clearly shows that the barriers are providing little noise reduction since the change in level from the Reference microphones to the field microphones is essentially the same with or without the barriers at all sites.

A separate but related topic investigated in the study was the possible diffraction effects at microphones placed higher than five feet. The data from this part of the study was obtained only from the Willow Street site, using the fifteen-foot microphones at L1P2 and L2P2. The insertion losses for these positions were determined using the same method as for all other positions. No frequency analysis of the data was undertaken because of time, personnel, and budget limitations.

Both "before" and "after" sample sizes are similar to those obtained at the other positions at Willow Street and at the other sites as well. (Table II, page 19) In addition, the median levels are between those for R and those for the five-foot positions in each case, which might be expected (Table III, page 21). However, although the insertion loss at L1P2 (Table IV, page 25) is close to those from the five-foot positions at all sites, it is not from the same population. Neither, of course, is the L2P2 insertion loss, which is far greater.

It is relatively simple to explain the <u>difference</u> between these two insertion losses. If the line of sight from L1P2 across the top of the barrier is projected to ground level, it can be seen that the only noise sources from which this microphone is shielded are those on the berm. There is no shielding from roadway noise at this

TABLE V

MEDIAN TRAFFIC COUNTS AND SPEEDS

PER FIVE-MINUTE OBSERVATION

SITE		NEAR SIDE						FAR SIDE			
		SPEED		CARS		TRUCKS		CARS		TRUCKS	
		FULL SAMPLE	SMALL SAMPLE	FULL SAMPLE	SMALL SAMPLE	FULL SAMPLE	SMALL SAMPLE	FULL SAMPLE	SMALL SAMPLE	FULL SAMPLE	SMALL SAMPLE
East Iselin Parkway	B	58.2	58.0	260.0	265.0	0	0	325.0	331.0	0	0
	A	59.4	60.0	269.1	267.3	2.9	3.6	318.5	315.0	1.0	0.8
East Louis Place	B	58.3	58.1	282.5	281.0	1	1	329.0	322.0	0	0
	A	57.8	57.8	279.6	295.4	2.7	3.3	328.2	342.5	1.7	0.8
Willow St.: R-L1P1, L1P2 Combination	B	---	---	211.0	219.0	0	0	205.0	199.0	0	0
	A	58.2	58.1	345.9	316.4	2.7	1.8	294.8	280.8	0.9	0.9
Willow St.: R-L2P1, L2P2 Combination	B	---	---	219.5	220.0	1	1	211.5	210.0	1.0	1.0
	A	58.2	57.6	313.1	350.0	2.5	1.8	292.7	277.3	1.8	1.8
Control Site	B	60.9	60.6	242.0	235.0	0	0	252.0	259.0	0	0
	A	54.6	54.6	272.5	270.0	2.5	3.4	297.0	280.5	3.3	4.1

B - Before Barrier Construction
A - After Barrier Construction

TABLE VI

BEFORE AND AFTER BARRIER CONSTRUCTION DIFFERENCES BETWEEN MEDIAN Leq'S FOR REFERENCE AND FIELD MICROPHONES

SITE		REFERENCE(R)	L1P1	R-L1P1	L2P1	R-L2P1	L1P2	R-L1P2	L2P2	R-L2P2
East Iselin Parkway	B	77.1	67.5	9.6	64.8	12.3	---	---	---	---
	A	69.2	58.1	11.1	57.5	11.7	---	---	---	---
East Louis Place	B	76.1	65.7	10.4	62.8	13.3	---	---	---	---
	A	68.6	57.4	11.0	56.4	12.2	---	---	---	---
Willow St.: R-L1P1, L1P2 Combination	B	77.5	68.4	9.1	---	---	75.0	2.5	---	---
	A	70.5	60.5	10.0	---	---	66.9	3.6	---	---
Willow St.: R-L2P1, L2P2 Combination	B	76.8	---	---	64.0	12.8	---	---	71.5	5.3
	A	70.8	---	---	57.8	13.0	---	---	61.5	9.3
Control Site	B	79.8	68.5	11.3	64.5	15.3	---	---	---	---
	A	72.0	62.2	9.8	58.9	13.1	---	---	---	---

B - Before Barrier Construction
A - After Barrier Construction
L1 - Location 1
L2 - Location 2
P1 - Position 1
P2 - Position 2

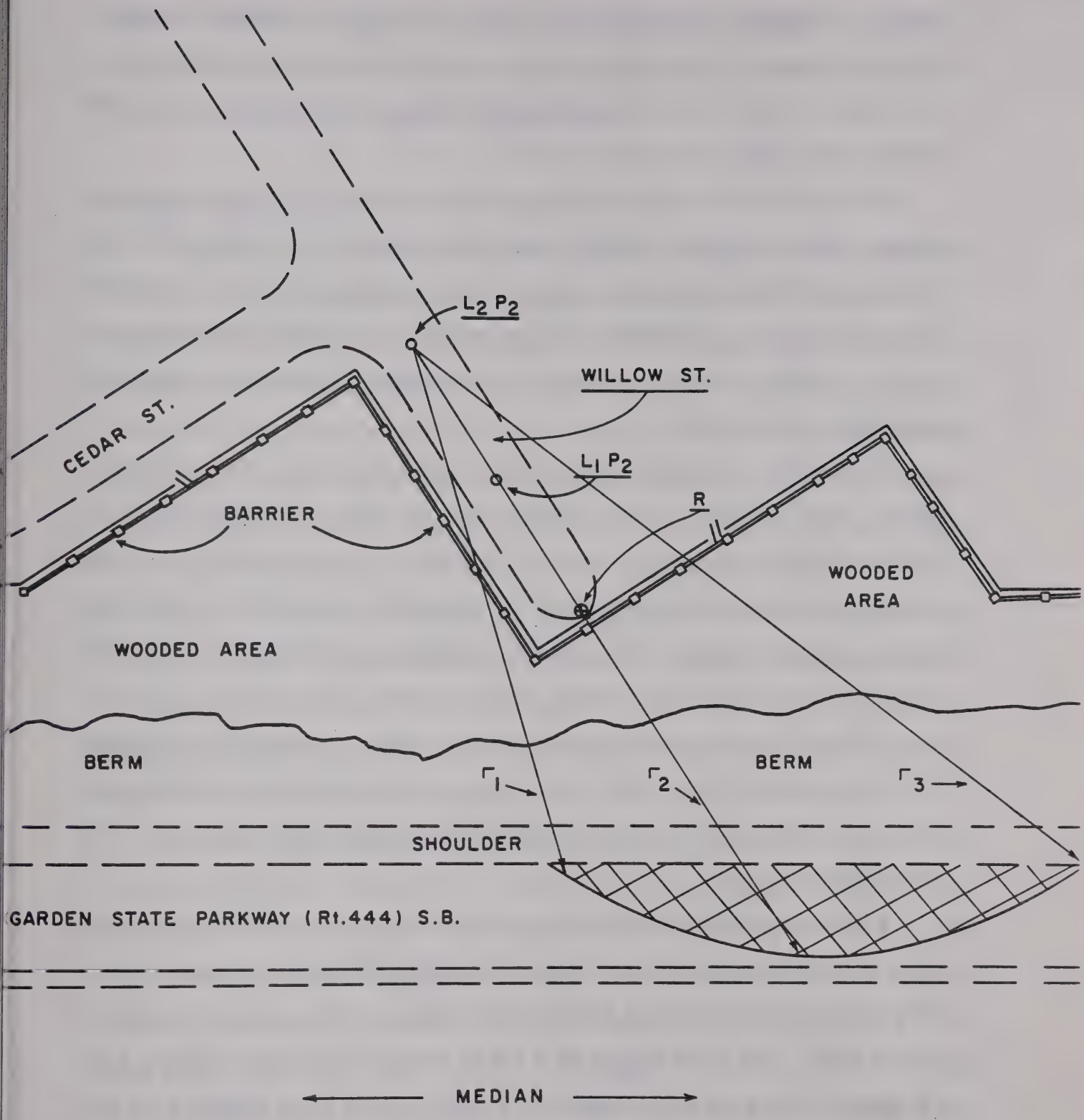

FIGURE 9

EFFECT OF BARRIER ON $L_2 P_2$

position. In contrast, the line of sight for L2P2 is broken over a substantial portion of the nearside roadway. This is shown by the arc approximately determined by r_1, r_2, r_3, in Figure 9, page 29. This shielding could easily account for the much higher insertion loss at L2P2, as compared to L1P2.

The explanation for the higher actual insertion loss at L2P2 is not so clearcut. Insertion loss is a relative quantity, and in this instance the relative difference between the "before" and "after" median levels is greater than at any other field microphone position. Considerable attention was given to finding a verifiable reason for this, but none was found. However, a non-verifiable but nevertheless reasonable explanation can be offered.

The "before" data was collected in April; the "after" data was collected in August. Thus the unusually high insertion loss at L2P2 could be due to a no-foliage/full-foliage comparison of levels. This would not have affected the other microphone positions since almost all of the foliage was well above the top of the barrier, at about the height of the Reference microphone. Furthermore, most of the trees were between R and L2P2. There was no unbroken line of sight to the roadway from L2P2, and in fact there was at least 40 feet of foliage of varying density between this position and any traffic noise source. So in addition to the barrier breaking the line of sight over a large portion of the roadway, the tree foliage did so as well and over an even larger area.

While it is generally accepted that vegetation does not provide an effective noise barrier, unless it is very deep and dense, it is possible (although not provable) that there was attenuation due to the foliage in this instance, which could have lowered the level at L2P2. From Table VI, page 28 it can be seen that the R-L2P1 difference for WS2 "before" is 12.8 dB, and 13.0 dB for WS2 "after". The R-L2P2 difference for WS2 "before" is 5.3 dB, and 9.3 dB for WS2 "after". As already stated, L2P1 was not affected by the foliage because of its height, and L2P2 "before" was not affected

because there was no foliage in mid-April when the data was collected. Therefore it is reasonable to assume that the 9.3 dB drop in median level between R and L2P2 was due at least in part to the intervening tree foliage.

MODEL VERIFICATION

Table VII, page 32, is a comparison of the insertion losses and confidence limits resulting from the analysis of full-size samples, the small samples of "measured" L_{eq}'s, and the predicted L_{eq}'s from small samples. Table VIII, page 33, following shows the sample size used in the analysis for each type of sample. For the small sample of "measured" levels, the "before" and "after" differences at R and the insertion losses at the field microphones are recognizably (but not acceptably) close to those obtained from the full-size samples. On the other hand, the confidence limits are much broader in at least half the cases. This is due to the fact that the (randomly selected) observations in these cases contain the more extreme values, with relatively few intermediate ones. As explained in the Data Analysis section, the confidence limits are taken from the differences between pairs of L_{eq}'s. If all L_{eq}'s in a sample are relatively far apart in value, the differences will be correspondingly larger than from a sample with more closely spaced values.

For the small sample predicted levels, the reverse is true for the most part. The confidence limits are much tighter than those from the small sample "measured" data, and in fact would be acceptable as full-size sample confidence limits. This is because the values of the predicted L_{eq}'s are relatively close together, which in turn is due to the fact that many of the traffic counts for the randomly chosen observations do not vary greatly from each other. However, the changes in median L_{eq}'s at R and the insertion losses bear no resemblance to either the full-sample or small-sample "measured" values. This is also true of the levels determined for the Control Site.

Table IX, page 34, shows the "before" and "after" median L_{eq}'s for each

TABLE VII

COMPARISON OF INSERTION LOSSES AND 95% CONFIDENCE LIMITS - IN dB

SITE	REFERENCE*			LOCATION 1, POSITION 1			LOCATION 2, POSITION 1		
	FULL	SSM	SSP	FULL	SSM	SSP	FULL	SSM	SSP
East Iselin Parkway	7.9: +0.2, -0.3	7.5: +0.3, -0.4	-0.7: +0.3, -0.3	1.2: +0.3, -0.3	1.6: +0.5, -0.5	6.8: +0.5, -0.3	-0.5: +0.3, -0.3	-0.3: +0.5, -0.6	5.7: +0.6, -0.4
East Louis Place	7.5: +0.4, -0.2	7.3: +0.6, -0.6	4.7: +0.4, -0.4	1.0: +0.4, -0.4	1.1: +0.6, -0.5	2.4: +0.5, -0.4	-1.0: +0.3, -0.5	-1.2: +0.6, -0.9	1.1: +0.6, -0.5
Willow St.:R-L1P1, L1P2 Combination	6.8: +0.2, -0.3	7.0: +0.5, -0.3	-1.9 +0.4, -0.4	0.9: +0.6, -0.8	1.2: +1.5, -0.9	7.1: +0.4, -0.5	---	---	---
Willow St.:R-L2P1, L2P2 Combination	5.9: +0.2, -0.3	6.1: +0.5, -0.6	-1.8: +0.4, -0.5	---	---	---	0.3: +0.5, -0.6	0.2: +1.3, -1.4	1.3: +0.4, -0.6
Control Site**	7.8: +0.2, -0.2	7.8: +0.6, -0.6	0.1: +0.5, -0.3	-1.5: +0.3, -0.3	-2.0: +1.2, -0.9	-0.3: +0.4, -0.4	-2.3: +0.8, -0.7	-1.9: +2.1, -2.0	0.4: +0.7, .0.8

FULL: Results from full usable samples obtained from reduction of field measurements.
SSM: Results from randomly selected small samples of reduced field measurements.
SSP: Results from predictions based on randomly selected small samples of traffic counts.
* Not an insertion loss; this is the difference between the "before" and "after" median levels.
** No barrier at Control Site; these are the differences between the "before" and "after" median levels.

TABLE VIII

COMPARISON OF SAMPLE SIZES

SITE		REFERENCE			LOCATION 1, POSITION 1			LOCATION 2, POSITION 1		
		FULL	SSM	SSP	FULL	SSM	SSP	FULL	SSM	SSP
East Iselin Parkway	B	55	15	15	28	7	7	27	8	8
	A	104	15	15	68	13	15	52	13	15
East Louis Place	B	44	15	15	19	7	7	25	8	8
	A	82	15	15	58	14	15	36	13	15
Willow St.: R-L1P1, L1P2 Combination	B	33	15	15	28	10	15	--	--	--
	A	104	15	15	88	14	15	--	--	--
Willow St.: R-L2P1, L2P2 Combination	B	28	13	15	--	--	--	43	13	15
	A	93	15	15	--	--	--	63	10	15
Control Site	B	65	15	15	40	8	8	25	7	7
	A	125	14	15	118	14	15	111	13	15

FULL: Total number of data points resulting from reduction of field measurements.
SSM: Number of randomly selected data points taken from full sample of reduced data.
SSP: Number of predicted L_{eq}'s obtained from randomly selected small samples of traffic counts.

TABLE IX

COMPARISON OF MEDIAN Leq'S FOR EACH TYPE OF SAMPLE CONSIDERED

SITE		REFERENCE			LOCATION 1, POSITION 1			LOCATION 2, POSITION 1		
		FULL	SSM	SSP	FULL	SSM	SSP	FULL	SSM	SSP
East Iselin Parkway	B	77.1	77.0	71.7	67.5	67.5	65.0	64.8	64.6	62.8
	A	69.2	69.4	72.3	58.1	58.0	58.9	57.5	57.5	57.7
East Louis Place	B	76.1	76.0	71.9	65.7	65.7	65.9	62.8	62.5	64.2
	A	68.6	68.9	67.4	57.4	57.4	58.8	56.4	56.4	58.4
Willow St.: R-L1P1, L1P2 Combination	B	77.5	77.5	71.1	68.4	68.1	68.4	---	---	---
	A	70.5	70.4	72.9	60.5	60.6	63.3	---	---	---
Willow St.: R-L2P1, L2P2 Combination	B	76.8	76.9	71.4	---	---	---	64.0	64.4	68.3
	A	70.8	70.8	73.2	---	---	---	57.8	57.8	68.8
Control Site	B	79.8	79.8	69.8	68.5	68.3	66.9	64.5	64.8	65.4
	A	72.0	72.0	69.8	62.2	62.0	67.1	58.9	58.8	65.1

FULL: Results from full useable samples of reduced field measurements.
SSM: Results from randomly selected small samples of reduced field measurements.
SSP: Results from predicted levels, calculated from randomly selected small samples of traffic counts.

classification of sample. Of the 26 predicted level entries, only 5 could be considered close to those from either of the other two classifications.

The last point to be considered is the fact that the "before" and "after" medians for the full-size samples and the randomly selected short samples are from different populations. The "before" and "after" medians for the predicted levels are all from the same population. For both the full-size and randomly selected short samples of "measured" levels, there is a definite drop at R (which is not affected by the barrier) for all barrier sites and the Control Site. The reduction from "before" to "after" clearly shows that the major portion of the noise reduction was due to the reconstruction of the highway. Therefore, there can be no doubt that STAMINA 2.0 does not accurately predict noise levels under the conditions of this study.

It must be emphasized however that STAMINA 2.0 has been validated and applied nationwide with repeated success. Therefore it is possible that the unusual traffic mix found on this highway (<1% medium trucks and <<1% heavy trucks) may have presented parameters outside of the capabilities of this model.

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APPENDIX I

DATA COLLECTION PROCEDURE

Figures 10 and 11 on pages 40 and 41 show the equipment layout used for data collection. A three-man crew was necessary for this part of the project. The procedure was as follows:

1. The instrumentation van was positioned so that only one 100-foot cable was needed to reach any microphone;
2. The tripods, cables, microphones, and mast for the microphones at Location 1, Location 2, and the Reference were positioned and connected;
3. Simultaneously the tape recorders, voice microphones, timers, sound level meters, and ancillary items were set up in the instrumentation van;
4. A preliminary announcement consisting of the tape number, date, location, site, name, "before" or "after" barrier construction and signal weighting was recorded on each tape;
5. Pistonphone calibration signal was recorded for each channel in use, followed by an announcement for the start of Observation 1;
6. The traffic and weather vehicle was positioned on the Route 444 berm, and the radar set up and calibrated;
7. Initial wind speed and temperature readings were obtained and recorded;
8. The equipment operator was informed of the weather data and the readiness of the traffic data crew;
9. The equipment operator gave the starting signal to the traffic data crew via walkie-talkie and then started the tape recorders and the

timer. The traffic crew counted three classes of vehicles: light, medium trucks, and heavy trucks, for both the eastbound and westbound roadways. At least ten radar speed readings were recorded during each observation. Observations were nominally six minutes minimum but often they were longer to allow for portions containing extraneous noise (planes, mowers, etc.) to be edited out during data reduction;

10. The equipment operator entered pertinent information such as meter settings, starting time and duration of each observation, etc. on forms provided for this purpose. He also noted any unusal noise such as that from planes or trains which might have to be edited out when the observation was reduced to obtain an L_{eq} for traffic noise only;
11. At the end of the observation the operator stopped the recorders and the timer and signalled the traffic data crew to stop. He then recorded the end of the observation and the start of the next one on the tape.
12. Upon being given the ready signal from the traffic data crew, the operator signalled the start of the next observation, repeating the applicable preceding steps.

Because of equipment limitations, it was possible to record data from no more than four microphones simultaneously. Therefore, at Willow Street noise was recorded for the R-L1P1, L1P2 combination, and then for R-L2P1, L2P2 combination.

APPENDIX I

MAJOR ITEMS OF DATA COLLECTION EQUIPMENT

1 - 2204 B & K Sound Level Meter

1 - 2209 B & K Sound Level Meter (in reserve)

2 - 4420 B & K Pistonphone (1 in reserve)

2 - Model IV-SJ Nagra tape recorders

4 - 1" B & K Microphones with preamps, input stages, random incidence correctors, windscreens, dessicators (1 set in reserve)

1 - MPH K-55 Radar

1 - Headphones

3 - Walkie-talkies

1 - Stopwatch

2 - Microphone masts for microphones set higher than 5 feet

2 - Tripods for microphones set at five feet

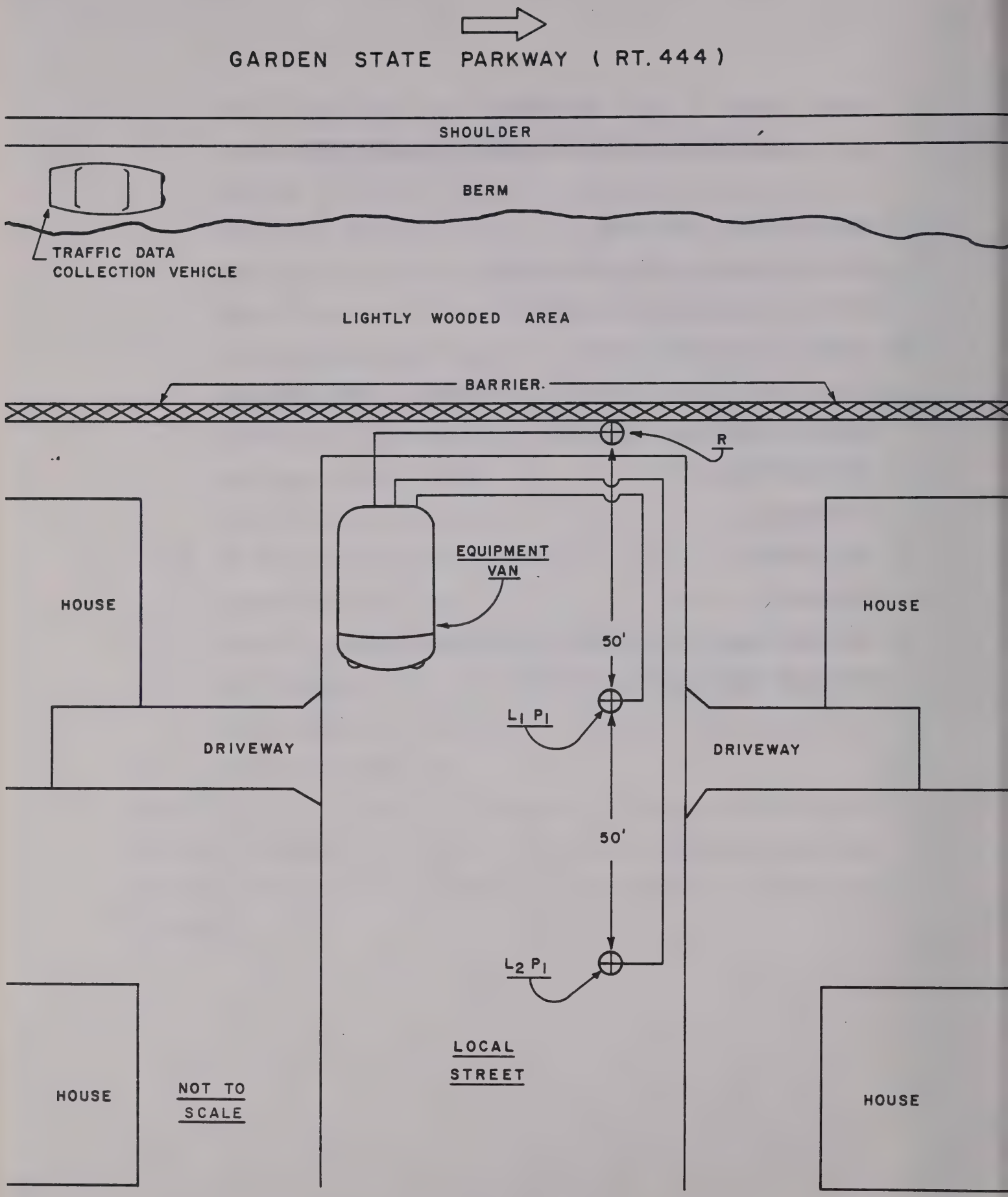
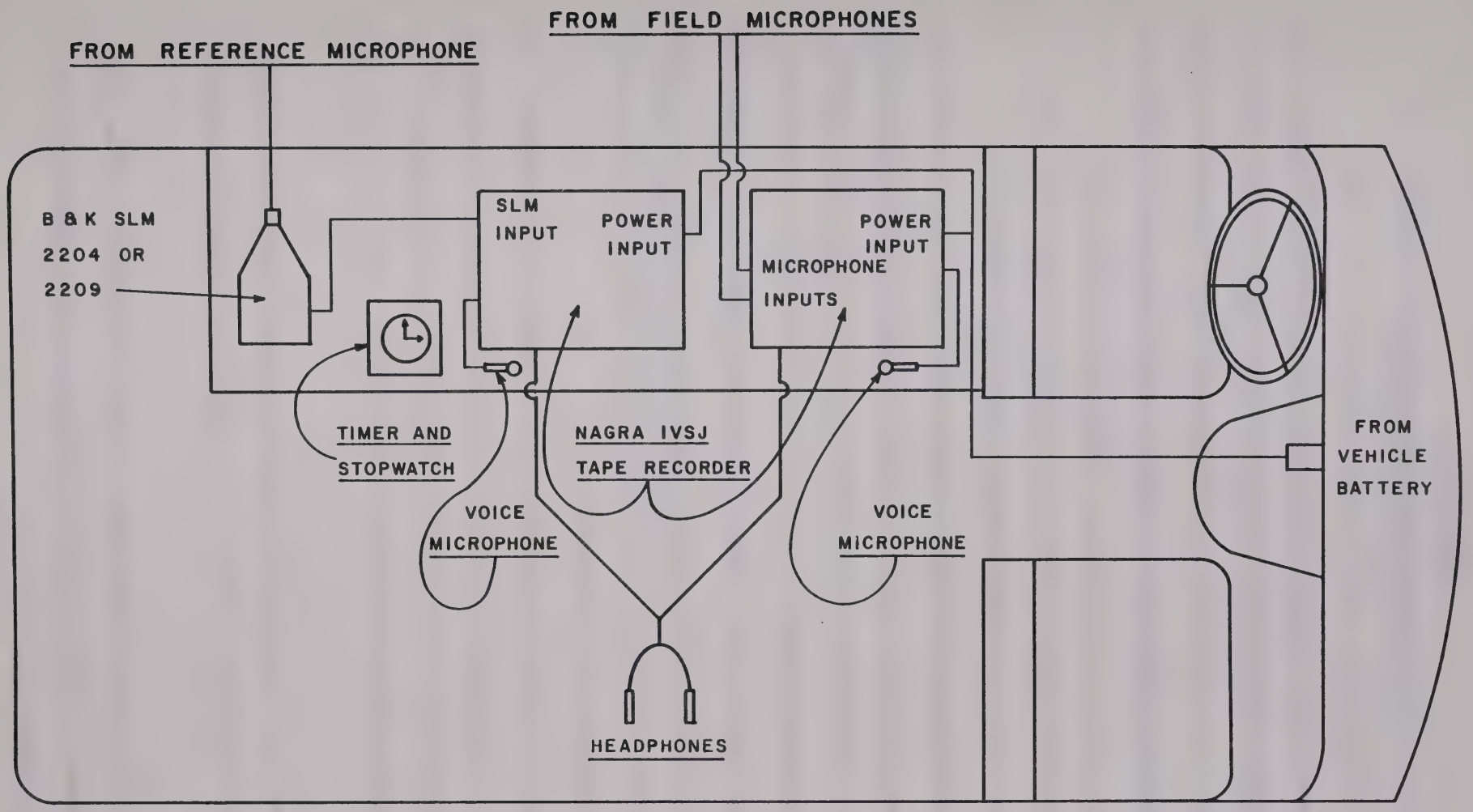


FIGURE 10

TYPICAL VAN AND MICROPHONE POSITIONING



NOT TO SCALE

FIGURE 11

DATA COLLECTION EQUIPMENT LAYOUT

APPENDIX II

DATA REDUCTION PROCEDURE

Data reduction was accomplished by one man. Editing of tapes was done by the same person throughout the entire data reduction process in order to ensure uniformity of results. Types of extraneous noise edited from the tapes included that from aircraft, trains, municipal equipment and vehicles, private and commerical vehicles, pedestrians, and general neighborhood noises. The routine was as follows:

1. The data reduction equipment was set up as shown in Figure 12, page 45;
2. All controls were set for proper readings, levels, speeds, etc.;
3. The tape was started on playback and the graphic level recorder pen set at the appropriate level to record the calibration signal. The 1/3-octave band analyzer was checked for the correct L_{eq}. The calibration signal was checked for uniform level;
4. The voice announcement following calibration signal was checked for necessary information (tape number, date, observation number, etc.) and to ascertain that it agreed with field notes. This information was written on the graph at the start of the first observation;
5. The graph of the first observation on the channel was recorded. By consulting the field notes and listening to the monitor speaker it was possible to determine where extraneous noises occurred during the observation. The type of noise and the start and stop of each occurrence were marked on the graph;
6. At the end of the observation the voice announcement was checked, the start of the next observation indicated on the graph, and reduction proceeded as before;
7. At the end of the last observation the tape was checked for final voice announcement and calibration signal. The tape was then rewound to the start of the first observation;

8. The tape was rerun on the same channel, using the graph and a timer to obtain 5m of traffic noise for each observastion, where available. Observations not meeting this requirement were discarded;

9. The Statistical Distribution Analyzer readings for all observations having 5m of traffic noise were recorded;

10. At the end of the last observation the tape was rewound and Steps 3 - 10 were repeated for each channel;

11. All Statistical Distribution Analyzer readings for 5m of traffic noise were converted to L_{eq}'s using a computer program.

The speed of the near side traffic was determined by averaging the radar readings taken during the observation. A minimum of 10 readings were taken each time. All traffic counts were prorated from the actual count obtained during the observation. For instance, a light vehicle count of 198 for a six-minute observation was prorated by taking $\frac{5m}{6m} \times 198 = 165$

Prorated counts were reported to the nearest tenth.

APPENDIX II

MAJOR ITEMS OF DATA REDUCTION EQUIPMENT

1 - B & K 2305 Graphic Level Recorder

1 - B & K 4420 Statistical Distribution Analyzer

1 - Spectral Dynamics SD312-22 1/3-Octave Analyzer

1 - IV - SJ Nagra Tape Recorder

1 - Misco Monitor Speaker

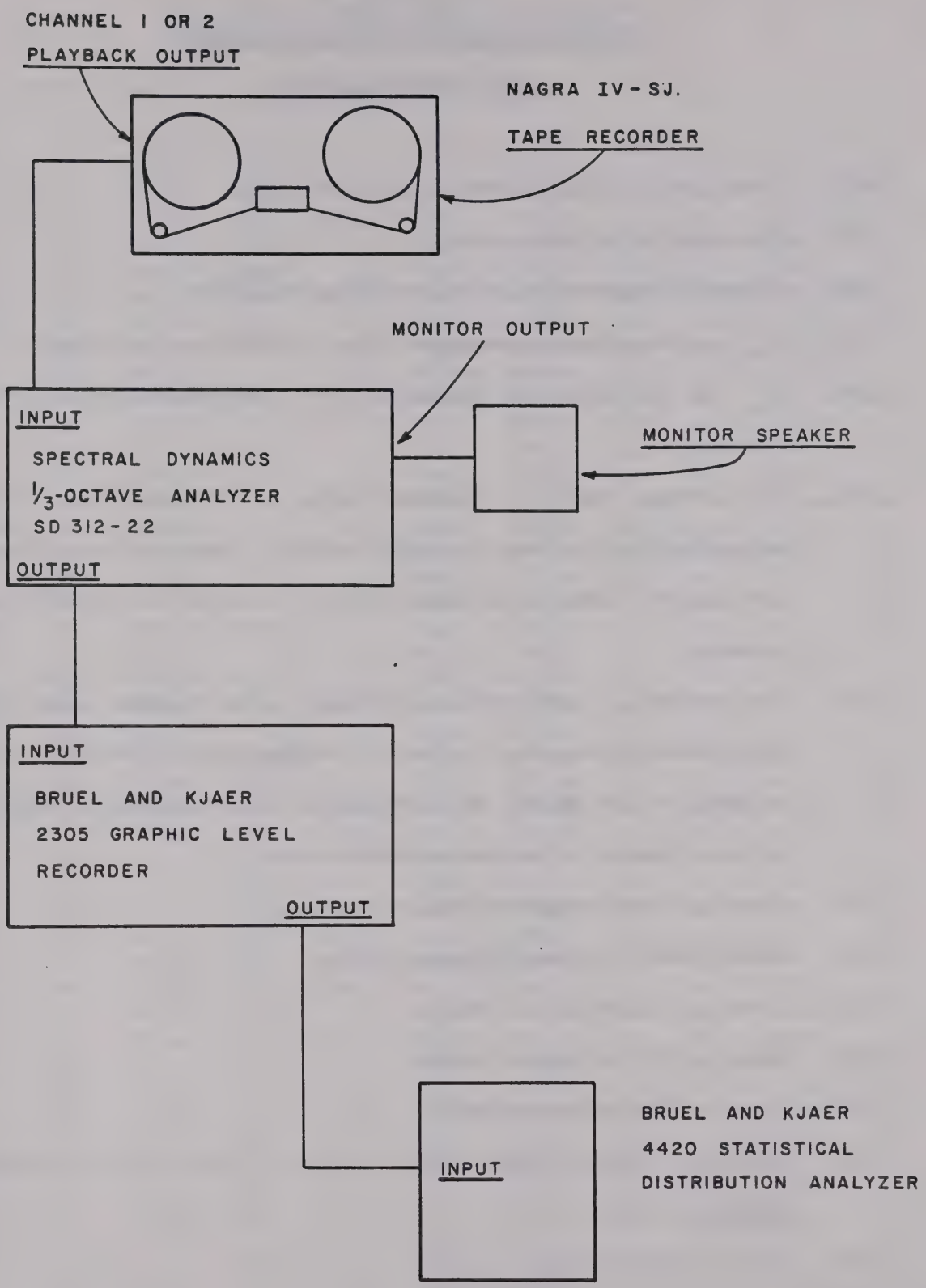


FIGURE 12
DATA REDUCTION EQUIPMENT LAYOUT

EXPLANATION OF COLUMN HEADINGS

FOR APPENDICES III-IX

OBS - Total number of usable observations to this point.

DATE - Date observation was recorded.

OBSNO - Sequential observation number for the particular date.

REF - L_{eq} for the particular observation from the Reference microphone.

LxPy - L_{eq} for the particular observation from the microphone at Location x, Position y.

SPD - The average speed of nearside traffic for the particular observation, determined from at least ten radar readings. Speeds were not taken during the "before" Willow Street data collection because the radar unit was being repaired.

NSL - The number of light vehicles travelling in the nearside lanes during the observation, prorated to 5m from the original count. The prorated count is reported to the nearest tenth, except for the Willow Street "before" data, which is reported to the nearest whole number.

NSM - Same as above for nearside medium trucks.

NSH - Same as above for nearside heavy trucks.

FSL - Same as NSL for farside traffic.

FSM - Same as NSM for farside traffic.

FSH - Same as NSH for farside traffic.

NST - Nearside trucks for Willow Street "before"; trucks were not classified as to medium or heavy.

FST - Same as NST for farside trucks.

APPENDIX III
RT. 444 - EAST ISELIN PARKWAY
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
1	7/13/81	1	68.4	60.2	.	56.6	278.2	0.9	0.0	349.1	0.9	0.9
2	7/13/81	2	67.2	57.9	.	54.4	273.5	1.8	0.9	319.4	0.9	0.0
3	7/13/81	3	67.4	59.0	.	59.2	248.3	2.5	0.0	312.5	0.8	0.0
4	7/13/81	4	67.3	58.6	58.4	55.7	268.2	6.4	0.0	307.3	2.7	0.0
5	7/13/81	5	66.7	59.8	.	57.6	248.2	1.8	0.0	298.2	2.7	0.9
6	7/13/81	7	67.3	58.3	.	56.0	272.9	0.9	2.7	259.1	5.4	0.0
7	7/13/81	8	67.8	.	62.4	56.4	308.2	3.6	0.0	288.2	0.0	0.9
8	7/13/81	9	67.6	.	.	55.3	280.0	1.7	0.0	307.5	0.8	0.0
9	7/13/81	10	67.6	.	.	54.8	328.2	0.9	0.0	330.9	2.7	0.0
10	7/13/81	11	67.2	.	57.2	57.4	250.5	3.2	2.4	282.2	1.6	0.0
11	7/13/81	12	67.7	.	.	57.2	308.8	4.4	0.9	337.9	0.0	0.0
12	7/13/81	14	67.5	.	57.6	55.3	345.5	1.0	0.0	336.8	1.0	0.0
13	7/14/81	4	67.6	.	.	57.7	235.3	0.8	0.0	317.9	2.3	0.0
14	7/14/81	5	68.0	.	.	58.1	243.2	0.8	0.0	359.2	0.0	0.0
15	7/14/81	6	67.4	.	.	58.1	241.4	1.4	0.0	325.0	0.7	0.0
16	7/14/81	7	67.4	.	.	60.6	216.4	2.8	0.0	317.9	1.4	0.0
17	7/14/81	8	67.1	.	.	58.5	247.3	0.9	0.0	341.8	0.9	0.0
18	7/14/81	9	67.4	.	.	59.3	270.0	0.0	0.0	282.7	0.9	0.0
19	7/14/81	10	67.9	.	.	60.2	245.0	1.7	0.0	278.3	1.7	0.0
20	7/14/81	11	67.4	59.7	.	54.7	272.7	5.4	0.0	272.7	2.7	0.0
21	7/14/81	12	67.7	.	.	58.6	259.1	1.7	0.0	283.6	2.5	0.0
22	7/14/81	13	67.5	60.3	.	59.1	246.4	2.7	0.0	309.1	0.0	1.8
23	7/14/81	14	67.7	.	.	60.3	265.4	0.9	0.0	283.6	6.4	0.0
24	7/14/81	16	67.7	.	.	59.4	263.8	1.6	0.0	295.9	3.3	0.0
25	7/14/81	18	67.1	59.8	.	59.4	279.1	2.7	0.0	300.9	0.9	0.0
26	7/16/81	1	69.8	57.7	57.3	59.5	272.6	1.8	0.0	322.9	1.8	0.9
27	7/16/81	2	69.9	57.9	57.3	60.2	263.5	3.5	0.0	319.1	0.9	0.0
28	7/16/81	3	70.4	58.7	58.3	60.8	271.5	3.0	0.0	305.2	3.0	0.0
29	7/16/81	4	69.1	57.7	57.5	59.7	290.9	2.7	0.0	323.6	0.9	0.0
30	7/16/81	5	69.7	58.2	57.4	61.0	258.2	3.6	0.0	344.5	0.0	0.0
31	7/16/81	6	69.0	57.4	57.1	61.6	316.2	5.7	0.0	354.3	1.0	0.0
32	7/16/81	7	69.4	58.1	57.5	61.5	286.7	4.2	0.0	293.3	2.5	0.0
33	7/16/81	8	69.2	57.5	56.9	61.8	298.3	2.6	0.0	274.8	0.9	0.0
34	7/16/81	9	68.9	57.8	56.7	61.8	240.0	2.5	0.0	275.8	0.0	0.0
35	7/16/81	10	68.0	57.0	.	62.0	221.7	0.0	0.0	269.2	0.0	0.0
36	7/16/81	11	69.6	58.1	57.0	61.9	282.5	4.2	0.0	268.3	0.8	0.0
37	7/16/81	12	69.4	58.0	.	60.9	275.0	1.7	0.0	270.0	0.0	0.0
38	7/16/81	13	70.0	58.2	57.3	62.4	277.5	3.3	0.0	319.2	0.0	0.0
39	7/16/81	14	69.7	58.6	57.4	61.3	280.7	1.4	0.7	249.0	0.0	0.0
40	7/16/81	15	70.3	58.4	57.7	60.8	255.2	3.4	0.0	229.0	0.7	0.0
41	7/16/81	16	70.4	.	.	62.3	325.8	5.0	0.0	280.0	0.0	0.0
42	7/16/81	17	70.5	59.2	57.6	62.5	364.2	7.5	0.0	305.8	0.0	0.0
43	7/16/81	18	70.5	58.9	58.2	61.0	360.8	3.3	0.0	301.6	0.0	0.0
44	7/17/81	1	70.0	.	.	55.4	242.7	5.4	0.0	412.7	3.6	0.0
45	7/17/81	2	70.1	57.7	57.5	56.4	275.4	1.8	4.5	336.4	1.8	1.8
46	7/17/81	3	69.9	57.7	57.6	54.9	272.7	1.8	1.8	382.7	3.6	2.7
47	7/17/81	4	69.9	58.2	.	55.1	234.5	0.9	0.9	403.6	0.9	0.0
48	7/17/81	5	69.9	.	.	57.0	286.4	2.7	0.9	355.4	1.8	0.9
49	7/17/81	6	69.9	58.7	58.0	58.1	325.4	2.7	0.9	410.0	4.5	0.0

APPENDIX III
RT. 444 - EAST ISELIN PARKWAY
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
50	7/17/81	7	70.1	58.0	57.7	56.0	280.6	8.4	0.0	367.6	0.0	0.0
51	7/17/81	8	69.2	57.3	57.1	58.3	289.9	2.5	0.0	371.8	5.1	0.0
52	7/17/81	9	69.4	57.3	56.7	55.5	298.3	3.4	0.0	314.4	3.4	0.8
53	7/17/81	10	69.3	.	.	55.8	274.4	2.6	0.9	317.6	1.8	0.0
54	7/17/81	11	68.9	57.1	.	54.7	283.0	3.4	0.0	327.0	0.8	0.0
55	7/17/81	12	69.8	57.4	56.6	57.5	296.8	0.0	2.4	344.6	2.4	0.0
56	7/17/81	13	68.7	56.8	55.9	58.0	248.5	1.5	0.0	343.8	3.1	0.8
57	7/17/81	14	69.4	58.5	55.9	56.2	324.5	3.6	0.0	389.1	0.0	0.0
58	7/17/81	15	70.2	58.6	57.5	58.6	305.4	4.5	0.0	376.4	4.5	0.0
59	7/17/81	16	70.0	58.3	57.6	58.7	327.3	4.5	1.8	402.7	1.8	0.0
60	7/17/81	17	70.0	58.1	57.5	57.3	374.5	4.5	0.0	375.4	1.8	0.0
61	7/17/81	18	69.8	58.1	57.4	57.5	380.0	1.8	0.9	414.5	1.8	6.4
62	7/17/81	19	70.9	59.3	58.2	57.4	457.3	4.5	1.8	348.2	6.4	0.0
63	7/17/81	20	70.1	57.8	57.2	56.3	369.0	3.0	0.0	374.2	0.0	3.0
64	7/17/81	21	69.7	58.5	57.7	57.2	360.0	0.6	4.5	390.9	0.0	1.8
65	7/21/81	1	69.5	59.9	.	61.4	279.1	1.7	0.0	370.0	3.3	0.8
66	7/21/81	2	68.9	.	.	61.7	256.7	0.0	0.0	306.7	1.7	0.0
67	7/21/81	3	69.1	58.9	57.7	62.2	238.3	0.0	0.0	332.5	0.8	0.0
68	7/21/81	4	68.7	58.6	.	60.6	248.3	1.7	0.0	330.8	0.8	0.8
69	7/21/81	6	68.4	58.8	57.7	60.7	257.4	1.9	0.0	368.7	0.0	0.0
70	7/21/81	7	.	59.3	58.2	60.9	232.9	1.6	0.0	279.5	0.0	0.0
71	7/21/81	8	69.0	58.3	.	61.1	238.3	4.2	0.0	321.6	0.0	0.0
72	7/21/81	9	68.3	57.7	57.3	61.0	215.4	0.0	0.0	273.0	0.0	0.0
73	7/21/81	10	69.2	58.0	57.5	60.1	238.3	0.8	0.0	273.3	2.5	0.0
74	7/21/81	11	69.0	58.1	57.3	59.6	249.2	1.7	0.0	304.2	0.0	0.8
75	7/21/81	13	68.8	.	.	61.2	220.9	6.4	0.0	261.8	0.0	0.0
76	7/21/81	14	74.5	59.1	.	60.4	246.9	4.6	0.0	344.6	0.0	0.0
77	7/21/81	15	68.8	.	.	60.0	249.4	2.8	0.0	255.0	0.6	0.0
78	7/21/81	16	69.5	.	.	58.9	232.7	2.7	0.0	300.0	0.9	0.0
79	7/21/81	17	69.3	59.7	58.0	60.0	267.3	3.6	0.0	281.8	0.0	0.0
80	7/22/81	1	71.1	57.7	56.8	61.0	249.2	1.7	0.0	346.7	1.7	0.0
81	7/22/81	2	71.6	.	.	59.7	223.6	2.7	0.0	379.1	0.0	0.0
82	7/22/81	3	71.6	58.0	57.5	60.7	259.1	3.6	0.0	378.2	1.8	0.0
83	7/22/81	4	71.5	58.2	57.4	59.9	259.2	2.5	0.0	365.0	1.7	0.0
84	7/22/81	5	.	57.9	57.5	60.8	234.2	0.8	0.0	338.3	0.8	0.0
85	7/22/81	6	71.3	58.0	57.6	60.8	230.0	5.8	0.0	315.0	0.8	0.0
86	7/22/81	7	71.1	57.7	57.4	59.8	247.5	3.3	0.0	331.7	0.0	0.0
87	7/22/81	8	68.2	.	.	60.4	234.2	1.7	0.0	282.5	1.7	0.0
88	7/22/81	9	69.2	.	.	59.1	271.7	7.5	0.0	300.0	4.2	0.0
89	7/22/81	10	69.2	.	.	59.1	248.0	6.0	0.0	250.0	1.3	0.0
90	7/22/81	11	69.3	.	.	57.6	276.7	5.0	0.0	277.5	0.8	0.8
91	7/22/81	12	69.2	.	.	59.4	255.6	4.1	0.0	236.7	0.0	0.0
92	7/22/81	13	69.7	.	.	59.9	260.8	9.1	0.0	325.8	0.0	0.0
93	7/22/81	14	69.7	.	.	58.6	315.4	7.3	0.0	323.6	0.0	0.0
94	7/22/81	15	70.2	58.6	.	59.3	300.0	8.8	0.0	268.1	1.2	0.0
95	7/22/81	16	70.3	.	.	59.4	255.8	1.7	0.0	310.8	0.8	0.0
96	7/22/81	17	70.4	.	.	58.9	320.0	4.5	0.0	323.6	0.0	0.0

APPENDIX IV
RT. 444 - EAST LOUIS PLACE
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
1	7/23/81	2	68.8	57.2	55.2	59.4	310.9	5.4	0.0	401.8	3.6	0.0
2	7/23/81	4	68.6	56.9	55.6	58.6	196.2	2.3	0.0	333.8	2.3	0.0
3	7/23/81	5	67.7	56.6	55.6	58.6	273.2	2.4	0.0	377.8	1.6	0.0
4	7/23/81	6	68.3	56.6	55.1	58.6	203.7	3.7	0.0	293.3	2.2	0.0
5	7/23/81	9	68.3	56.4	.	58.2	262.5	4.2	0.0	333.3	1.7	0.0
6	7/23/81	10	67.9	56.2	53.6	59.1	221.7	1.7	0.0	281.7	0.8	0.0
7	7/23/81	11	67.7	56.1	54.6	58.9	251.7	4.2	0.0	275.8	2.5	0.0
8	7/23/81	14	67.9	56.0	.	59.2	282.7	2.7	0.0	326.4	1.8	0.0
9	7/23/81	15	68.7	56.3	.	58.4	253.6	1.8	0.9	347.2	2.7	0.0
10	7/24/81	1	68.8	56.8	56.7	58.9	295.7	5.1	0.0	393.4	2.6	0.9
11	7/24/81	2	69.0	.	.	59.9	285.8	7.5	0.0	422.5	4.2	0.0
12	7/24/81	5	68.5	56.8	.	60.1	270.8	3.2	0.0	415.3	0.8	0.0
13	7/24/81	7	68.1	56.4	.	57.6	266.7	3.3	0.0	263.3	0.0	0.0
14	7/24/81	8	68.1	.	.	58.1	280.0	1.7	0.0	345.8	1.7	0.0
15	7/24/81	9	68.1	.	.	57.9	283.3	1.7	0.0	306.7	2.5	0.0
16	7/24/81	10	68.5	.	.	57.5	302.5	1.7	0.0	321.4	0.8	0.0
17	7/24/81	11	69.0	.	.	56.8	292.5	2.5	0.0	320.8	4.2	0.0
18	7/24/81	12	68.4	56.1	54.2	58.7	290.0	1.7	0.0	351.7	2.5	0.0
19	7/24/81	13	68.4	56.3	.	57.3	313.3	1.7	0.0	350.8	3.3	0.0
20	7/24/81	14	67.8	.	.	56.8	314.2	2.5	0.0	340.8	3.3	0.0
21	7/24/81	15	69.3	.	.	57.8	325.0	5.0	0.8	365.0	2.5	0.0
22	7/24/81	16	67.8	56.3	.	55.7	342.5	3.3	0.0	376.7	4.2	0.0
23	7/24/81	17	69.0	57.2	55.0	57.9	332.0	6.0	0.0	378.0	0.7	0.0
24	7/24/81	19	69.2	.	.	56.9	369.2	3.3	0.0	395.0	1.7	0.0
25	7/24/81	20	69.2	57.4	.	57.8	360.8	2.5	0.0	421.7	5.0	0.0
26	7/27/81	1	69.0	58.8	57.4	56.8	308.2	4.5	0.0	406.4	2.7	0.0
27	7/27/81	2	.	59.0	.	56.2	338.2	1.8	0.0	432.7	3.6	0.0
28	7/27/81	3	69.2	.	57.4	55.8	300.0	2.7	0.0	436.4	10.0	0.0
29	7/27/81	4	69.6	58.6	57.4	57.1	336.7	5.0	0.0	397.5	1.7	0.0
30	7/27/81	5	.	58.6	.	55.4	276.7	3.3	0.0	409.2	1.7	0.0
31	7/27/81	6	.	59.3	.	55.9	324.5	2.7	0.0	382.7	3.6	0.0
32	7/27/81	7	.	58.7	.	57.0	325.0	5.8	0.0	415.8	1.7	0.0
33	7/27/81	8	68.5	57.7	.	57.8	289.2	1.7	0.0	321.6	1.7	0.0
34	7/27/81	9	67.8	57.3	56.2	57.9	280.0	1.8	0.0	380.9	4.5	0.0
35	7/27/81	10	67.7	57.9	.	56.7	269.2	2.5	0.0	320.8	3.3	0.0
36	7/27/81	11	.	57.8	.	57.4	268.5	1.5	0.0	313.1	0.8	0.0
37	7/27/81	12	67.7	57.6	56.5	57.2	273.1	1.9	0.0	342.5	3.1	0.0
38	7/27/81	13	67.6	57.6	.	56.8	270.0	0.0	0.0	307.5	1.7	0.0
39	7/27/81	14	.	57.7	.	56.9	239.1	1.8	0.0	291.8	5.4	0.0
40	7/27/81	15	68.7	57.9	.	57.5	299.2	5.8	0.0	340.0	2.5	0.0
41	7/27/81	16	68.5	57.5	.	57.2	287.5	1.7	0.0	331.7	0.8	0.0
42	7/27/81	17	68.9	.	57.2	57.5	332.5	2.5	0.0	321.4	1.7	0.0
43	7/27/81	18	.	58.1	56.9	57.8	279.1	0.0	0.0	315.4	2.7	0.9
44	7/27/81	19	.	57.8	.	57.6	321.8	0.0	0.0	340.0	2.7	0.0
45	7/27/81	20	68.7	57.8	56.7	59.2	335.8	0.0	0.0	234.1	0.0	0.0
46	7/27/81	21	68.6	.	.	58.9	295.0	4.2	0.0	330.0	2.5	0.0
47	7/28/81	1	68.1	.	.	57.1	273.3	3.3	0.0	369.2	6.7	0.8
48	7/28/81	2	68.0	.	.	57.3	273.6	3.6	0.0	433.6	1.8	0.0
49	7/28/81	3	68.7	.	.	57.0	270.9	2.7	0.0	441.8	0.0	0.0

APPENDIX IV
RT. 444 - EAST LOUIS PLACE
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
50	7/28/81	4	67.3	.	.	56.7	235.8	0.0	0.0	447.5	10.7	0.0
51	7/28/81	5	67.9	.	.	57.4	246.4	3.6	0.0	404.5	2.7	0.0
52	7/28/81	6	67.3	.	.	57.9	211.8	2.7	0.0	530.9	1.8	1.8
53	7/28/81	7	67.8	.	.	58.0	260.8	0.8	0.0	495.0	2.5	0.0
54	7/28/81	8	69.3	.	.	57.6	270.0	5.0	0.8	294.1	0.8	0.0
55	7/28/81	9	68.9	.	.	58.4	248.2	4.5	0.0	303.6	0.9	0.0
56	7/28/81	10	68.1	.	.	57.9	229.2	2.5	0.0	310.0	0.8	0.8
57	7/28/81	11	68.9	.	.	56.9	238.3	3.3	0.0	295.8	0.0	0.0
58	7/28/81	13	69.2	.	.	57.5	248.3	1.7	0.0	338.3	0.0	0.0
59	7/28/81	14	69.8	58.0	.	58.0	238.5	3.8	0.0	322.3	0.8	0.0
60	7/28/81	15	69.2	.	.	58.4	304.3	2.1	0.0	316.4	0.7	0.0
61	7/28/81	16	69.3	.	.	58.2	275.0	6.7	0.0	284.1	0.8	0.0
62	7/28/81	17	69.3	.	.	59.3	275.0	2.5	0.0	307.5	0.0	0.0
63	7/28/81	18	69.1	56.9	54.9	57.3	295.4	3.8	0.0	304.6	0.0	0.0
64	7/28/81	19	70.0	.	.	56.9	316.7	1.7	0.0	311.6	0.8	0.0
65	7/28/81	20	69.2	57.0	55.9	57.9	282.5	2.5	0.0	350.0	0.8	0.0
66	7/28/81	21	69.0	.	.	57.5	316.7	4.2	0.0	320.0	0.0	0.0
67	7/30/81	1	68.2	.	56.6	57.0	250.3	0.8	0.0	325.0	2.5	0.0
68	7/30/81	2	69.3	57.9	56.5	58.4	274.5	1.8	0.0	336.4	0.9	0.0
69	7/30/81	3	69.3	58.3	57.1	57.7	287.3	5.4	0.0	303.6	1.8	2.7
70	7/30/81	4	68.8	57.7	56.4	59.1	266.7	1.7	0.0	300.0	0.8	0.0
71	7/30/81	5	68.9	57.9	56.3	58.3	241.8	5.4	0.0	318.2	0.0	0.0
72	7/30/81	6	69.7	58.4	.	58.3	283.3	3.3	0.8	356.7	0.0	0.0
73	7/30/81	7	68.4	57.9	.	57.9	275.8	0.8	0.0	291.7	1.7	0.8
74	7/30/81	8	69.5	57.6	56.4	57.9	268.5	3.8	0.8	306.2	0.8	0.0
75	7/30/81	9	68.3	56.8	55.0	57.1	279.1	2.5	0.0	310.0	0.0	0.0
76	7/30/81	10	68.1	56.7	55.2	57.1	238.3	2.5	0.8	251.7	0.0	0.0
77	7/30/81	11	68.5	57.0	56.1	58.2	279.1	2.5	0.0	330.0	0.8	0.0
78	7/30/81	12	68.6	57.1	56.0	57.3	267.5	1.7	0.0	320.8	0.8	0.0
79	7/30/81	13	67.7	56.9	.	55.5	247.3	2.7	0.0	320.9	0.9	0.0
80	7/30/81	14	67.2	56.6	54.8	55.6	244.5	2.7	0.0	304.5	1.8	0.9
81	7/30/81	15	68.4	56.6	56.3	56.8	276.7	3.3	0.0	281.7	0.0	0.0
82	7/30/81	16	68.4	56.7	56.5	57.3	290.0	5.0	0.0	265.0	0.0	0.0
83	7/30/81	17	68.5	57.1	.	58.1	287.5	4.2	0.0	289.2	1.7	0.0
84	7/30/81	18	68.2	.	.	58.5	285.4	1.8	0.0	334.5	0.0	0.0
85	7/30/81	19	68.8	57.5	57.4	56.8	315.8	4.2	0.0	307.5	0.8	0.0
86	7/30/81	20	68.5	57.1	57.0	57.9	323.6	3.6	0.0	304.5	0.9	0.0
87	7/30/81	21	68.4	.	.	59.0	279.1	5.0	0.0	295.8	0.8	0.0
88	7/30/81	22	69.7	.	.	57.9	330.8	5.8	0.0	365.0	0.0	0.0
89	7/30/81	23	69.5	58.4	56.7	58.3	303.3	4.2	0.0	367.5	0.8	0.0
90	7/30/81	24	69.1	57.8	56.8	57.2	339.1	3.3	0.0	319.2	0.8	0.0

APPENDIX V
RT. 444 - WILLOW STREET 1
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L1P2	SPD	NSL	NSM	NSH	FSL	FSM	FSH
1	8/03/81	1	71.2	67.0	62.1	57.4	315.2	2.4	0.0	259.2	0.8	0.0
2	8/03/81	2	71.0	67.2	62.2	56.5	374.2	2.5	0.0	303.3	3.3	0.0
3	8/03/81	3	70.1	66.7	.	59.2	294.1	0.8	0.0	287.5	0.8	0.0
4	8/03/81	4	70.9	67.3	62.1	58.7	377.3	2.7	0.0	307.3	0.9	0.0
5	8/03/81	5	70.3	66.9	61.9	56.9	345.0	0.8	0.0	284.1	1.7	0.0
6	8/03/81	6	70.4	67.3	62.3	56.6	324.0	3.3	0.0	271.7	0.8	0.8
7	8/03/81	7	70.6	67.4	62.2	57.7	314.2	1.7	0.0	280.8	0.0	0.0
8	8/03/81	8	70.5	66.2	60.4	57.1	265.0	3.3	0.0	296.6	4.2	0.0
9	8/03/81	9	71.3	66.8	61.9	57.2	327.3	1.8	0.0	331.8	0.9	0.0
10	8/03/81	10	70.6	66.9	.	57.6	317.5	3.3	0.0	326.4	2.5	0.0
11	8/03/81	11	71.2	67.0	62.0	58.0	346.4	2.8	0.0	333.6	2.8	0.0
12	8/03/81	12	70.8	67.1	62.0	58.8	355.4	1.8	0.0	392.7	3.6	0.0
13	8/03/81	13	71.0	67.3	62.4	57.3	373.1	3.8	0.0	302.3	1.5	0.8
14	8/03/81	14	71.4	67.5	62.5	57.7	374.2	5.0	1.7	334.1	2.5	0.0
15	8/04/81	1	70.6	.	66.8	58.5	316.4	0.0	0.0	329.1	2.7	0.0
16	8/04/81	2	70.8	68.2	66.4	58.2	342.7	0.9	0.0	340.0	2.7	0.0
17	8/04/81	3	70.8	.	66.9	56.9	324.2	1.7	0.0	357.3	0.0	0.0
18	8/04/81	4	70.1	68.1	65.9	52.9	363.6	2.5	0.0	288.2	5.4	0.0
19	8/04/81	6	71.0	68.8	66.1	58.7	378.2	0.0	0.0	481.8	0.9	0.0
20	8/04/81	7	70.8	.	67.6	58.7	348.3	2.5	0.0	566.7	1.7	0.0
21	8/04/81	8	69.6	.	65.7	58.2	313.1	1.9	0.0	250.6	0.0	0.0
22	8/04/81	10	69.0	67.9	65.1	57.8	255.8	0.8	0.8	262.5	0.0	0.0
23	8/04/81	11	69.4	69.0	66.3	58.8	277.5	1.7	0.0	251.7	0.0	0.0
24	8/04/81	12	68.8	67.5	64.5	57.2	275.4	5.4	0.0	251.8	0.0	0.0
25	8/04/81	13	69.3	68.3	65.7	57.4	316.4	5.4	0.0	277.3	0.0	0.0
26	8/04/81	14	69.3	68.2	65.2	58.7	289.2	2.5	0.0	277.5	0.0	0.0
27	8/04/81	15	69.5	67.0	64.7	59.1	286.7	1.7	0.0	280.8	0.0	0.0
28	8/04/81	16	70.1	67.5	64.9	59.6	288.2	1.8	0.0	260.0	3.6	0.0
29	8/04/81	17	69.9	67.5	65.3	59.9	323.3	3.3	0.0	284.1	1.7	0.0
30	8/04/81	18	71.1	67.3	66.9	58.8	353.3	1.7	0.0	320.0	0.8	0.0
31	8/04/81	19	70.5	.	.	57.8	317.5	0.8	0.0	323.3	0.8	0.8
32	8/04/81	20	70.3	.	65.7	58.4	331.7	3.3	0.0	323.3	1.7	0.0
33	8/04/81	21	70.5	66.9	65.8	58.8	317.5	3.3	0.0	335.8	1.7	0.0
34	8/07/81	1	71.0	66.9	59.9	57.7	359.1	4.5	0.0	376.4	0.9	0.9
35	8/07/81	2	70.4	66.2	59.7	57.4	294.5	3.9	0.0	388.4	2.4	0.0
36	8/07/81	3	70.4	66.0	59.1	57.9	338.1	0.9	0.0	371.8	1.8	0.0
37	8/07/81	4	71.0	67.1	60.4	57.8	371.5	1.5	0.0	428.5	1.5	0.8
38	8/07/81	5	71.0	67.3	60.4	58.8	402.6	4.3	0.0	406.1	4.3	0.9
39	8/07/81	6	71.1	67.2	60.6	56.3	467.2	6.4	0.0	420.0	0.8	0.0
40	8/07/81	7	71.2	67.1	60.2	59.2	419.2	4.1	0.0	352.6	0.0	0.0
41	8/07/81	8	71.2	66.9	59.5	57.4	334.1	4.2	0.0	284.1	4.2	0.0
42	8/07/81	9	71.0	66.7	60.0	58.6	338.3	5.0	0.0	300.0	1.7	0.0
43	8/07/81	10	70.8	.	.	58.4	353.3	3.3	0.8	285.8	6.7	0.0
44	8/07/81	11	70.5	65.8	58.8	58.7	334.5	4.5	0.0	294.5	0.9	0.0
45	8/07/81	12	70.8	66.4	59.2	56.3	398.2	5.4	0.0	315.4	0.9	0.0
46	8/07/81	13	70.8	67.3	.	58.9	360.8	3.3	0.0	307.5	0.0	0.0
47	8/07/81	14	70.6	66.3	59.9	58.6	417.3	5.4	0.0	318.2	1.8	0.0
48	8/07/81	15	71.8	66.8	59.9	59.3	406.7	4.2	0.0	333.3	3.3	0.0
49	8/07/81	16	71.0	66.1	59.2	57.9	395.4	3.6	0.0	362.7	2.7	0.0

APPENDIX V
RT. 444 - WILLOW ST. 1
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L1P2	SPD	NSL	NSM	NSH	FSL	FSM	FSH
50	8/07/81	17	71.2	66.0	59.6	58.8	403.6	1.8	0.0	348.2	2.7	0.0
51	8/07/81	18	71.7	66.9	60.7	59.1	414.2	5.8	0.0	350.0	3.3	0.0
52	8/11/81	1	70.9	66.5	.	58.2	345.4	3.6	0.0	379.1	0.0	0.0
53	8/11/81	2	70.9	66.6	60.4	55.9	386.7	1.7	0.8	305.8	0.0	0.0
54	8/11/81	3	70.5	66.3	.	57.6	327.5	4.2	0.0	276.7	0.8	0.0
55	8/11/81	5	70.9	66.8	60.5	57.0	370.8	4.2	0.0	300.0	0.0	0.0
56	8/11/81	6	69.7	65.2	59.0	58.8	327.5	0.8	0.0	280.0	0.0	0.0
57	8/11/81	7	70.4	66.3	60.0	56.2	362.5	1.7	0.8	280.8	1.7	0.0
58	8/11/81	8	70.2	66.5	59.8	58.8	290.8	1.7	2.5	236.6	0.8	0.0
59	8/11/81	9	70.0	.	.	59.4	256.7	1.7	0.8	295.0	0.0	0.0
60	8/11/81	10	69.0	63.1	.	57.9	285.8	0.8	0.0	265.0	0.0	0.0
61	8/11/81	11	69.5	66.3	59.5	56.7	273.3	1.7	0.8	280.8	0.0	0.0
62	8/11/81	12	69.1	.	.	58.6	287.3	0.9	0.0	245.4	0.0	0.0
63	8/11/81	13	68.9	65.8	58.6	58.4	295.0	1.7	0.0	281.7	0.0	0.0
64	8/11/81	14	68.4	65.1	57.8	58.2	269.2	0.8	0.0	292.5	0.8	0.0
65	8/11/81	16	.	65.6	59.0	59.1	288.2	0.9	0.9	276.7	0.9	0.0
66	8/11/81	17	69.4	65.9	59.3	57.6	288.2	0.9	0.0	298.2	0.0	0.0
67	8/11/81	18	70.1	66.3	59.2	58.6	319.2	0.8	0.0	336.4	0.0	0.0
68	8/11/81	19	.	66.4	59.7	58.5	316.4	1.8	0.9	348.2	0.0	0.0
69	8/11/81	20	70.0	66.3	59.7	59.2	280.0	1.7	0.0	294.1	0.0	0.0
70	8/11/81	21	69.5	65.5	58.5	58.1	319.2	1.7	0.0	343.3	1.7	0.0
71	8/13/81	1	70.5	66.8	59.6	57.0	359.2	2.3	0.0	259.2	1.5	0.0
72	8/13/81	2	70.6	66.8	59.5	56.1	445.4	2.7	0.9	246.4	1.8	0.0
73	8/13/81	3	70.6	67.0	59.8	57.7	436.7	2.5	0.8	246.7	0.0	0.0
74	8/13/81	4	70.6	66.9	59.8	58.7	480.0	3.6	0.0	233.6	0.0	0.0
75	8/13/81	5	70.2	66.6	59.9	56.5	437.3	0.0	0.0	250.0	0.0	0.0
76	8/13/81	6	71.1	67.6	60.3	57.1	520.0	1.8	1.8	270.9	1.8	0.0
77	8/13/81	7	70.3	.	.	57.5	461.8	6.4	0.0	279.1	0.0	0.0
78	8/13/81	8	70.2	66.3	59.1	57.9	257.3	3.6	0.9	267.3	8.3	0.0
79	8/13/81	9	70.3	66.2	59.3	57.4	327.3	2.7	0.0	271.8	0.9	0.0
80	8/13/81	10	70.3	66.3	59.3	57.0	305.4	0.9	0.0	255.4	3.6	0.0
81	8/13/81	11	70.4	66.4	.	58.7	333.6	0.0	0.0	264.5	3.6	0.0
82	8/13/81	12	69.8	65.9	58.9	57.5	267.3	2.7	0.0	272.7	2.7	0.0
83	8/13/81	13	69.8	66.1	59.1	59.5	314.2	1.7	0.0	275.4	6.7	0.0
84	8/13/81	14	70.3	66.5	59.3	58.7	294.5	5.4	0.0	304.5	3.6	0.0
85	8/14/81	1	71.1	67.3	60.9	58.1	426.4	4.5	1.8	287.3	0.0	0.0
86	8/14/81	2	71.1	66.3	59.8	57.8	421.8	2.7	0.0	253.6	0.9	0.0
87	8/14/81	3	71.2	67.0	60.4	58.4	388.3	2.5	0.0	286.7	0.8	0.0
88	8/14/81	4	71.2	66.8	60.8	57.8	410.8	2.5	0.0	283.3	0.0	0.0
89	8/14/81	5	70.8	66.8	60.6	58.2	423.3	2.5	2.5	320.8	0.0	0.0
90	8/14/81	6	71.0	66.9	61.1	58.6	385.8	5.0	0.0	413.3	1.7	0.0
91	8/14/81	7	71.3	67.2	.	58.5	416.7	8.3	0.0	260.0	1.7	0.0
92	8/14/81	8	70.5	66.8	60.9	56.4	414.5	1.8	0.0	251.8	0.0	0.9
93	8/14/81	9	70.3	67.0	.	57.7	396.8	2.4	0.0	247.2	0.0	0.0
94	8/14/81	10	70.8	66.9	60.4	59.6	356.7	6.7	0.0	243.3	0.8	0.0
95	8/14/81	12	70.7	67.1	.	58.6	398.2	5.4	0.0	335.4	0.9	0.0
96	8/14/81	13	70.3	.	.	59.0	355.8	2.5	0.0	325.0	1.7	0.0
97	8/14/81	14	70.7	66.5	60.7	58.4	376.9	6.9	0.0	296.2	0.0	0.0
98	8/14/81	15	70.3	66.8	60.0	58.6	336.7	1.7	0.0	285.8	2.5	0.0

APPENDIX V
RT. 444 - WILLOW ST. 1
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L1P2	SPD	NSL	NSM	NSH	FSL	FSM	FSH
99	8/14/81	16	70.3	67.2	60.9	59.3	374.2	5.0	0.0	265.0	0.0	0.0
100	8/14/81	17	70.3	67.1	61.2	58.8	381.7	0.8	0.0	320.8	1.7	0.0
101	8/14/81	18	70.7	67.5	60.7	59.3	366.4	2.7	0.0	357.3	0.9	0.0
102	8/14/81	19	70.4	67.1	60.7	59.5	415.4	2.7	0.0	369.1	0.9	0.0
103	8/14/81	20	70.0	67.0	.	59.2	370.8	3.3	0.8	332.5	0.0	0.0
104	8/14/81	21	70.2	67.1	61.1	57.7	401.7	2.5	0.0	340.0	1.7	0.8

APPENDIX VI
RT. 444 - WILLOW STREET 2
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L2P1	L2P2	SPD	NSL	NSM	NSH	FSL	FSM	FSH
1	8/17/81	1	70.9	62.1	57.5	56.6	453.6	0.9	0.0	277.3	1.8	0.0
2	8/17/81	2	71.1	62.2	57.5	57.6	486.9	1.5	0.0	291.5	0.8	0.0
3	8/17/81	3	70.8	62.0	57.4	57.8	507.7	1.5	0.0	273.1	0.8	0.0
4	8/17/81	4	70.8	61.8	.	57.0	507.3	0.9	0.0	250.9	0.9	0.9
5	8/17/81	5	70.4	61.6	.	56.3	389.1	2.7	0.0	261.8	0.0	0.0
6	8/17/81	6	71.0	62.3	57.4	56.1	596.4	1.8	0.0	278.2	0.9	0.0
7	8/17/81	7	70.5	62.0	57.4	56.5	597.7	0.8	0.0	264.6	3.8	0.8
8	8/17/81	8	69.7	60.7	.	56.9	302.7	3.6	0.0	229.4	0.0	0.0
9	8/17/81	9	70.1	61.9	57.3	59.0	315.4	0.9	0.0	273.6	0.9	0.0
10	8/17/81	10	69.2	60.5	56.8	58.6	278.2	0.0	0.0	263.6	0.9	0.0
11	8/17/81	11	69.9	61.0	57.3	59.0	340.0	1.8	0.0	277.3	1.8	0.9
12	8/17/81	12	69.5	61.4	57.3	57.9	300.9	3.6	0.0	292.7	2.7	0.9
13	8/17/81	13	69.2	61.1	.	58.4	316.7	1.7	0.0	268.2	0.8	0.0
14	8/17/81	14	68.6	.	.	59.7	269.1	1.8	0.0	290.9	3.6	0.0
15	8/17/81	15	69.7	60.7	57.0	58.4	326.6	2.5	0.0	313.3	0.0	0.0
16	8/17/81	16	70.5	61.8	.	58.6	340.0	1.7	0.0	300.0	3.3	0.0
17	8/17/81	17	70.4	61.6	57.4	58.5	343.6	1.8	0.0	310.9	1.8	0.0
18	8/17/81	18	70.5	61.7	.	58.2	347.2	7.3	0.0	280.0	2.7	0.0
19	8/17/81	19	70.2	61.5	.	58.2	323.3	3.3	0.0	316.7	4.2	0.0
20	8/17/81	20	70.7	62.2	57.4	58.9	325.8	4.2	0.0	344.1	8.3	0.8
21	8/17/81	21	69.9	61.5	.	58.6	310.8	1.7	0.0	295.8	4.2	0.0
22	8/18/81	1	71.6	.	.	57.1	395.8	3.3	0.0	377.5	0.0	0.0
23	8/18/81	2	71.8	.	.	58.3	367.3	3.6	0.0	390.9	0.9	0.0
24	8/18/81	3	71.5	60.8	57.6	59.1	361.8	2.7	0.0	371.8	0.9	0.0
25	8/18/81	4	71.0	59.9	57.5	54.7	398.2	3.6	0.9	439.1	0.0	0.0
26	8/18/81	5	71.6	59.9	57.8	58.6	394.2	3.3	0.0	467.5	0.0	0.0
27	8/18/81	6	71.1	60.6	57.6	57.9	359.2	0.0	0.0	377.5	2.5	0.0
28	8/18/81	7	71.5	59.4	57.6	58.7	382.5	3.3	0.0	363.3	2.5	0.0
29	8/18/81	8	70.9	59.3	57.3	60.1	299.1	3.5	0.0	230.4	0.0	0.0
30	8/18/81	9	70.8	.	.	59.0	296.4	5.4	1.8	260.0	0.0	0.0
31	8/18/81	10	70.0	.	.	58.9	277.3	1.8	0.0	259.1	0.0	0.0
32	8/18/81	11	70.6	59.3	57.3	60.2	294.5	1.8	0.0	273.6	0.9	0.0
33	8/18/81	12	70.3	59.5	57.0	58.2	304.2	5.0	0.0	235.8	1.7	0.0
34	8/18/81	13	70.2	59.2	57.3	57.9	247.3	2.7	0.0	257.3	1.8	0.0
35	8/18/81	14	70.1	59.8	.	57.3	307.5	0.0	0.0	229.2	1.7	0.0
36	8/18/81	15	.	59.3	.	60.2	320.9	1.8	0.0	264.5	0.0	0.0
37	8/18/81	16	70.4	60.5	57.6	59.4	319.1	5.4	0.0	281.8	0.9	1.8
38	8/18/81	17	70.3	59.7	57.6	59.4	317.3	4.5	0.0	264.5	0.0	0.0
39	8/18/81	18	70.6	60.3	.	58.6	350.0	4.2	0.0	294.1	0.0	0.0
40	8/18/81	19	70.7	60.2	57.8	59.8	330.0	1.7	0.0	282.5	0.0	0.8
41	8/18/81	20	70.6	60.5	57.8	59.5	345.8	2.5	0.0	315.8	0.0	0.0
42	8/18/81	21	70.6	61.1	57.8	59.4	325.8	4.2	0.0	265.0	2.5	0.0
43	8/19/81	1	72.0	62.6	59.6	59.6	430.5	4.9	0.0	371.4	2.4	0.0
44	8/19/81	2	71.8	62.6	59.7	57.5	417.5	5.8	0.8	345.8	5.0	0.8
45	8/19/81	3	71.4	62.2	59.2	58.9	419.1	1.8	0.0	322.7	1.8	0.0
46	8/19/81	4	71.6	62.4	59.2	58.1	412.2	2.6	0.0	398.3	1.6	0.0
47	8/19/81	5	71.7	61.9	59.7	57.3	426.7	2.5	0.0	321.6	4.2	0.0
48	8/19/81	6	71.4	62.3	59.2	57.7	402.5	0.0	0.0	396.7	5.8	0.0
49	8/19/81	7	71.5	62.4	59.6	57.6	389.1	0.9	0.0	370.6	0.9	0.0

APPENDIX VI
RT. 444 - WILLOW STREET 2
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L2P1	L2P2	SPD	NSL	NSM	NSH	FSL	FSM	FSH
50	8/19/81	8	70.8	60.2	59.5	59.5	300.0	2.7	0.9	254.5	2.7	0.0
51	8/19/81	9	70.6	60.5	58.7	58.7	299.1	1.8	0.0	245.4	0.9	0.0
52	8/19/81	10	69.9	61.5	57.9	58.4	265.0	0.8	0.8	255.0	0.0	0.0
53	8/19/81	11	70.9	60.7	60.7	58.4	302.7	2.7	0.0	245.4	2.7	0.0
54	8/19/81	12	70.4	60.8	58.5	57.2	293.3	3.3	0.0	261.7	4.2	0.8
55	8/19/81	13	70.3	60.7	58.4	57.2	291.7	0.8	0.0	245.0	0.0	0.8
56	8/19/81	14	70.7	61.2	.	59.1	308.3	0.8	0.0	282.5	0.8	0.0
57	8/19/81	15	.	61.5	58.4	58.0	291.7	1.7	0.0	298.3	0.8	0.8
58	8/19/81	16	.	62.1	59.4	57.8	386.4	4.5	0.0	306.4	1.8	0.0
59	8/19/81	18	.	62.1	59.1	58.5	329.2	0.0	0.0	324.2	4.2	0.0
60	8/19/81	19	.	62.4	59.3	57.8	325.4	3.6	0.0	333.6	6.4	0.0
61	8/19/81	20	.	61.4	59.2	58.9	303.3	1.7	0.0	319.2	5.8	0.0
62	8/19/81	21	.	61.9	60.1	59.4	290.8	3.3	0.0	311.6	5.8	0.0
63	8/24/81	1	71.1	.	.	56.9	289.2	2.5	0.0	389.2	2.5	0.0
64	8/24/81	2	71.3	.	.	57.6	295.8	0.8	0.0	375.8	0.0	0.0
65	8/24/81	3	71.5	.	.	57.8	278.3	1.7	0.0	390.0	2.5	0.0
66	8/24/81	4	71.7	.	.	57.1	274.2	2.5	0.8	406.7	2.5	0.0
67	8/24/81	5	71.5	61.2	57.6	57.5	282.5	1.7	0.0	443.3	2.5	0.0
68	8/24/81	6	71.5	.	.	58.2	291.8	1.8	0.0	410.0	0.0	0.0
69	8/24/81	7	70.9	60.6	.	58.5	280.0	3.3	0.0	374.2	2.5	0.0
70	8/24/81	8	71.2	60.8	57.7	58.9	283.5	3.5	0.0	402.6	4.3	0.0
71	8/24/81	9	71.2	60.5	.	58.1	275.4	4.5	0.9	376.4	1.8	0.0
72	8/24/81	10	71.1	61.4	.	58.3	284.9	4.2	0.0	344.1	3.3	0.0
73	8/24/81	11	71.0	60.3	57.6	58.5	298.6	2.1	0.0	362.1	2.9	0.0
74	8/24/81	12	71.4	.	.	58.2	293.6	1.8	0.0	341.8	2.7	0.0
75	8/24/81	13	70.9	60.3	57.3	57.5	220.0	1.8	0.0	321.8	5.4	0.0
76	8/24/81	14	70.8	.	.	58.6	258.3	3.3	0.0	319.2	0.8	0.0
77	8/24/81	15	70.9	60.6	.	57.4	299.2	1.7	0.0	305.8	3.3	0.0
78	8/24/81	16	70.8	61.2	.	59.1	261.8	7.3	0.0	293.6	3.6	0.0
79	8/24/81	17	70.4	61.0	.	58.8	278.2	6.4	0.0	275.4	4.5	0.0
80	8/24/81	19	70.9	62.0	57.8	57.9	349.1	4.5	0.0	322.7	4.5	0.0
81	8/24/81	20	71.1	61.3	58.2	58.1	317.3	3.6	0.0	336.4	1.8	0.0
82	8/24/81	21	70.9	61.2	57.7	57.4	335.3	2.4	0.0	345.9	3.5	0.0
83	8/25/81	1	70.6	62.4	.	57.1	348.2	4.5	0.0	257.3	0.0	0.0
84	8/25/81	2	70.9	62.6	.	57.5	359.2	2.5	0.0	266.7	4.2	0.0
85	8/25/81	3	70.8	63.0	58.7	57.3	399.2	1.7	0.0	338.3	5.0	0.0
86	8/25/81	4	70.8	62.8	.	57.1	363.3	0.8	0.0	255.8	1.7	0.0
87	8/25/81	5	70.9	62.6	58.0	57.9	336.4	2.7	0.0	258.2	2.7	0.0
88	8/25/81	6	71.4	62.9	57.9	57.7	367.3	3.6	0.0	250.9	0.0	0.0
89	8/25/81	7	71.3	62.7	58.3	57.6	332.3	1.5	0.0	218.5	1.5	0.0
90	8/25/81	8	70.1	62.3	57.7	58.6	296.4	1.8	0.0	251.8	0.9	0.0
91	8/25/81	9	70.0	62.4	.	56.2	273.6	4.5	0.0	283.6	1.8	0.0
92	8/25/81	10	70.6	62.5	57.9	58.9	298.2	3.6	0.0	257.3	1.8	0.0
93	8/25/81	11	70.2	62.2	.	58.3	273.6	0.0	0.0	282.7	2.7	0.0
94	8/25/81	12	70.9	62.5	57.7	58.4	300.9	0.9	0.0	292.7	0.0	0.0
95	8/25/81	13	70.3	62.5	57.7	58.8	263.3	0.0	0.0	292.7	1.7	0.0
96	8/25/81	14	70.2	62.7	58.1	57.3	271.7	5.8	0.0	273.3	0.8	0.0
97	8/25/81	15	70.6	.	.	58.7	303.6	0.9	0.0	284.5	2.7	0.0
98	8/25/81	16	70.7	62.8	57.8	58.1	303.9	2.9	0.0	287.4	1.0	0.0

APPENDIX VI
RT. 444 - WILLOW STREET 2
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L2P1	L2P2	SPD	NSL	NSM	NSH	FSL	FSM	FSH
99	8/25/81	17	70.5	62.8	.	58.5	259.4	1.0	0.0	285.5	3.9	1
100	8/25/81	18	69.6	62.4	57.3	57.6	222.7	4.5	0.9	335.4	1.8	0

APPENDIX VII
RT. 444 - CONTROL SITE
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
1	5/14/82	1	72.7	62.5	62.2	53.1	327.5	2.5	1.7	320.0	5.0	0.0
2	5/14/82	2	73.1	62.1	62.1	51.9	279.1	3.3	1.7	325.8	4.2	0.8
3	5/14/82	3	73.2	62.4	62.4	53.8	284.1	0.8	0.0	323.3	2.5	0.8
4	5/14/82	4	72.7	61.9	62.1	54.5	272.5	1.7	0.0	358.3	2.5	0.0
5	5/14/82	5	72.9	62.2	62.2	55.7	268.3	4.2	0.8	337.5	2.5	0.8
6	5/14/82	6	73.6	62.8	62.5	56.0	283.3	7.5	0.8	358.3	0.8	0.0
7	5/14/82	7	73.6	63.1	63.1	55.2	289.6	4.0	0.0	366.4	1.6	0.8
8	5/14/82	8	72.1	61.9	62.1	53.0	284.9	1.7	0.0	337.5	1.7	0.0
9	5/14/82	9	71.9	60.7	61.0	56.0	231.6	0.8	0.8	334.1	3.3	0.0
10	5/14/82	10	72.5	61.7	61.7	53.2	278.3	2.5	0.0	346.7	1.7	0.0
11	5/14/82	11	72.4	61.9	61.9	53.5	295.0	2.5	0.0	345.8	2.5	0.8
12	5/14/82	12	71.8	61.7	62.0	54.9	269.2	2.5	0.8	310.8	2.5	0.0
13	5/14/82	13	.	61.6	61.8	54.6	296.6	0.8	0.8	318.3	0.8	1.7
14	5/14/82	14	72.0	61.5	61.9	54.7	277.5	0.8	0.0	335.0	2.5	0.0
15	5/14/82	15	72.8	62.2	62.6	54.1	392.5	4.2	2.5	370.8	8.3	0.8
16	5/14/82	16	73.0	61.9	62.2	55.9	346.7	1.7	1.7	365.8	2.5	0.0
17	5/14/82	17	73.2	62.5	62.5	56.3	380.8	1.7	0.0	373.3	2.5	0.0
18	5/14/82	18	72.8	62.1	62.2	51.8	349.2	3.3	2.5	378.3	0.8	0.0
19	5/17/82	1	71.6	62.7	58.8	51.8	254.2	1.7	0.8	256.7	2.5	0.0
20	5/17/82	2	71.6	62.2	59.1	55.7	232.5	3.3	0.0	260.8	0.0	3.3
21	5/17/82	3	71.1	62.3	58.2	53.8	263.3	2.5	0.0	268.3	1.7	0.0
22	5/17/82	4	71.9	62.3	58.4	53.7	274.2	1.7	1.7	249.2	3.3	0.8
23	5/17/82	5	72.3	62.2	58.8	53.8	279.1	4.2	0.8	283.3	1.7	2.5
24	5/17/82	6	71.7	61.3	.	51.4	275.8	1.7	0.8	245.0	1.7	0.0
25	5/17/82	7	72.2	62.0	58.7	55.3	260.8	1.7	0.0	264.1	4.2	0.8
26	5/17/82	8	70.7	62.4	58.9	53.1	247.5	3.3	0.8	269.2	1.7	0.8
27	5/17/82	9	70.6	.	.	55.6	233.3	0.8	0.0	260.8	2.5	0.0
28	5/17/82	10	70.6	.	58.9	53.8	236.6	1.7	0.0	246.7	2.5	0.8
29	5/17/82	11	71.0	62.4	58.5	54.1	230.0	2.5	0.8	268.3	5.0	0.8
30	5/17/82	12	70.8	62.0	58.8	55.1	265.8	1.7	1.7	280.8	2.5	1.7
31	5/17/82	13	71.2	62.2	58.8	54.9	275.4	3.8	0.0	268.5	1.5	0.8
32	5/17/82	14	71.5	62.6	60.0	55.8	272.5	2.5	1.7	295.0	3.3	0.0
33	5/17/82	15	72.2	62.2	60.0	54.6	276.8	0.8	0.0	270.4	1.6	0.8
34	5/17/82	16	72.2	62.2	60.3	53.9	311.6	0.0	2.5	308.3	1.7	0.0
35	5/17/82	17	72.4	61.8	60.2	54.4	324.8	3.4	2.1	292.4	5.5	0.0
36	5/17/82	18	71.5	61.6	58.6	56.6	282.5	0.8	0.0	307.5	4.2	0.0
37	5/18/82	1	72.1	62.0	57.7	54.8	280.0	1.7	0.8	267.5	3.3	0.0
38	5/18/82	2	72.4	62.0	57.8	52.5	295.3	0.0	0.7	295.3	4.0	0.0
39	5/18/82	3	72.0	61.9	57.3	55.9	288.3	3.3	0.0	325.0	0.8	0.0
40	5/18/82	4	72.2	61.7	57.4	55.4	231.6	1.7	0.8	272.5	3.3	0.8
41	5/18/82	5	72.7	62.6	57.9	56.9	238.3	4.2	0.0	284.1	2.5	0.0
42	5/18/82	6	72.7	63.1	58.4	56.2	271.7	7.5	0.0	260.8	1.7	0.0
43	5/18/82	7	72.3	62.2	58.0	54.7	269.2	1.7	2.5	261.7	2.5	0.8
44	5/18/82	8	71.2	62.1	56.4	55.3	271.2	1.6	0.0	256.0	2.4	0.0
45	5/18/82	9	71.2	61.7	55.7	55.3	244.2	3.3	0.0	280.0	5.0	0.0
46	5/18/82	10	71.2	61.5	55.6	53.6	236.6	0.7	0.0	270.0	1.7	0.8
47	5/18/82	11	70.0	61.2	54.6	53.8	226.7	2.5	0.0	311.6	3.3	1.7
48	5/18/82	12	70.7	61.3	55.3	54.3	249.2	0.8	0.8	335.8	2.5	0.8
49	5/18/82	13	70.9	61.5	55.6	55.0	240.8	0.8	0.8	297.5	3.3	0.8

APPENDIX VII
RT. 444 - CONTROL SITE
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
50	5/18/82	14	71.4	62.3	57.0	53.8	247.5	5.8	0.0	274.2	0.8	1.7
51	5/18/82	15	71.1	61.7	59.8	54.8	282.5	4.2	3.3	262.5	8.3	0.0
52	5/18/82	16	70.8	61.5	59.5	53.2	303.3	3.3	0.0	300.0	4.2	0.0
53	5/18/82	17	71.1	61.5	58.3	51.1	287.5	0.0	0.0	297.5	0.8	0.0
54	5/18/82	18	71.7	62.0	58.8	52.4	305.8	0.8	0.8	295.8	0.0	0.0
55	5/18/82	19	71.5	62.3	58.8	52.7	269.2	5.0	4.2	269.2	2.5	0.0
56	5/18/82	20	71.3	62.2	.	54.5	323.3	0.8	3.3	347.5	0.8	0.0
57	5/18/82	21	72.0	62.7	59.5	52.6	343.3	2.5	2.5	320.0	5.8	3.3
58	5/26/82	1	72.3	62.2	58.1	54.3	252.8	5.6	0.0	290.4	6.4	6.4
59	5/26/82	2	72.2	62.6	58.3	52.8	260.0	0.0	0.0	305.8	0.8	2.5
60	5/26/82	3	71.8	62.2	57.7	53.0	269.2	0.0	0.0	260.5	2.4	0.8
61	5/26/82	4	71.9	62.6	58.2	54.5	244.2	0.8	0.0	275.8	0.8	2.5
62	5/26/82	5	72.2	62.5	.	54.6	272.4	0.0	0.8	295.1	2.4	0.0
63	5/26/82	6	72.0	62.6	57.8	55.9	265.0	0.8	0.0	294.1	1.7	0.0
64	5/26/82	7	71.9	61.8	57.6	54.0	270.0	2.5	0.8	265.0	1.7	0.8
65	5/26/82	8	71.6	62.2	58.5	52.7	259.5	1.6	0.0	313.0	1.6	1.6
66	5/26/82	9	71.9	.	.	57.0	260.8	0.8	0.0	342.5	1.7	0.0
67	5/26/82	10	71.9	61.9	.	56.4	250.8	4.2	0.8	297.5	5.0	0.0
68	5/26/82	11	72.1	62.4	58.2	55.5	225.3	3.3	0.0	308.7	1.3	0.7
69	5/26/82	12	72.0	.	58.5	52.5	230.8	0.8	0.0	325.0	5.0	0.8
70	5/26/82	13	71.1	62.1	57.8	57.0	225.8	3.3	0.0	313.3	1.7	0.8
71	5/26/82	14	71.0	61.3	57.3	55.3	220.0	2.7	0.8	295.8	1.7	0.0
72	5/26/82	15	72.1	62.0	56.0	53.8	296.6	0.8	0.0	276.7	1.7	0.0
73	5/26/82	16	71.7	61.7	56.8	54.6	286.7	0.0	0.0	276.7	3.3	0.0
74	5/26/82	17	.	62.8	56.8	53.2	304.2	4.2	0.0	295.0	4.2	0.0
75	5/26/82	18	.	61.8	56.3	53.8	283.2	5.6	0.8	281.6	6.4	1.6
76	5/26/82	19	72.2	62.0	57.2	54.0	255.8	2.5	1.7	311.6	3.3	0.0
77	5/26/82	20	72.8	61.7	56.6	54.5	247.5	4.2	0.0	312.5	1.7	2.5
78	5/26/82	21	73.3	62.5	58.7	54.2	298.3	5.8	7.5	309.2	0.8	1.7
79	5/27/82	1	72.4	62.4	59.4	53.4	272.5	2.5	0.0	255.0	3.3	1.7
80	5/27/82	2	73.0	62.9	59.7	54.4	286.7	1.7	0.0	264.1	5.0	1.7
81	5/27/82	3	72.7	63.4	60.5	55.4	270.0	3.3	1.7	263.3	5.0	0.8
82	5/27/82	4	72.1	63.2	59.3	53.7	285.4	0.0	4.8	270.0	4.0	0.0
83	5/27/82	5	73.0	63.3	58.8	55.2	293.3	1.8	5.0	280.8	0.8	3.3
84	5/27/82	6	71.8	62.4	57.5	54.4	255.0	3.3	0.8	278.3	3.3	0.8
85	5/27/82	7	72.7	62.8	57.8	56.4	280.8	0.8	0.8	302.5	0.8	0.8
86	5/27/82	8	71.9	62.4	58.4	55.4	265.0	1.7	0.0	227.5	2.5	0.0
87	5/27/82	9	71.8	62.0	58.6	55.7	269.2	3.3	0.0	230.0	4.2	0.0
88	5/27/82	10	71.8	62.2	58.4	53.0	305.4	2.3	0.0	283.1	0.8	0.8
89	5/27/82	11	71.4	.	57.6	53.4	267.5	0.0	0.0	299.2	3.3	0.8
90	5/27/82	12	71.4	62.2	57.7	54.3	247.3	0.0	0.8	345.4	0.0	0.0
91	5/27/82	13	72.2	.	58.4	55.6	264.1	2.5	0.8	291.7	4.2	0.0
92	5/27/82	14	71.4	62.3	57.9	55.1	268.3	1.7	0.8	312.5	5.0	0.8
93	5/27/82	15	72.1	62.7	59.3	54.9	267.5	5.0	0.8	278.3	1.7	5.0
94	5/27/82	16	71.9	.	.	54.5	290.0	2.5	0.0	298.3	3.3	0.8
95	5/27/82	17	72.1	.	59.5	54.7	274.0	4.0	1.6	306.5	2.4	3.2
96	5/27/82	18	71.8	62.6	.	53.9	271.6	3.2	0.8	316.6	2.4	1.6
97	5/27/82	19	71.8	62.5	.	54.8	281.7	1.7	0.0	310.8	5.0	1.7
98	5/27/82	20	72.4	63.0	60.0	55.3	323.3	1.7	0.8	316.7	3.3	3.3

APPENDIX VII
RT. 444 - CONTROL SITE
AFTER BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L2P1	SPD	NSL	NSM	NSH	FSL	FSM	FSH
99	5/27/82	21	72.0	62.6	58.7	57.2	285.8	6.7	0.0	316.7	0.8	0.8
100	5/27/82	22	72.5	62.8	60.0	54.6	283.3	1.7	0.0	341.7	1.7	0.0
101	5/27/82	23	72.9	62.9	61.0	54.5	350.0	4.2	2.5	386.7	7.5	0.8
102	5/27/82	24	72.6	62.3	60.5	53.9	350.7	1.4	1.4	344.3	2.1	1.4
103	5/27/82	25	72.1	62.4	59.1	56.9	346.9	0.8	0.8	328.5	0.8	1.5
104	5/27/82	26	72.0	62.0	61.5	56.5	295.4	1.5	0.8	370.8	7.7	0.8
105	6/03/82	1	72.7	62.7	62.2	56.3	302.5	0.8	0.8	328.3	3.3	4.2
106	6/03/82	2	72.5	62.4	62.0	54.6	299.2	3.3	0.8	270.0	1.7	0.8
107	6/03/82	3	72.5	62.6	62.0	58.1	280.5	2.4	0.0	290.3	0.8	3.2
108	6/03/82	4	72.3	62.2	61.3	56.0	249.2	1.7	0.0	253.3	2.5	0.0
109	6/03/82	5	72.4	62.1	61.3	55.5	280.8	2.5	0.0	300.0	2.5	1.7
110	6/03/82	6	72.1	61.9	60.9	53.3	230.7	2.8	0.0	252.9	0.7	2.1
111	6/03/82	7	71.9	61.7	60.6	54.4	252.5	0.8	0.8	278.3	1.7	0.8
112	6/03/82	8	72.2	.	.	54.1	239.2	5.7	1.6	287.0	0.0	0.8
113	6/03/82	9	71.6	61.7	60.7	58.2	249.2	1.7	0.0	289.2	1.7	0.0
114	6/03/82	10	72.0	61.8	60.2	55.9	270.0	0.8	0.0	310.5	1.6	0.0
115	6/03/82	11	72.7	62.4	61.3	55.8	261.7	1.7	0.0	335.8	1.7	0.0
116	6/03/82	12	72.8	61.9	60.3	54.4	236.6	2.5	0.8	310.8	2.5	0.8
117	6/03/82	13	72.4	.	60.9	56.6	282.5	2.5	0.0	230.0	0.0	0.8
118	6/03/82	14	71.7	61.5	59.9	55.5	238.3	0.0	0.0	293.3	1.7	0.8
119	6/03/82	15	70.8	61.6	.	57.9	231.6	3.3	4.2	313.3	0.0	1.7
120	6/03/82	16	71.8	62.2	.	51.8	288.3	1.7	3.3	300.0	2.5	0.8
121	6/03/82	17	70.3	61.8	.	54.4	259.2	2.5	0.0	283.3	0.8	0.0
122	6/03/82	18	70.9	61.9	.	52.0	270.8	0.0	0.8	289.2	0.8	0.8
123	6/03/82	19	71.7	61.9	.	55.2	270.8	4.0	1.6	308.9	0.8	0.0
124	6/03/82	20	72.4	62.0	.	53.7	289.2	5.0	0.8	296.6	4.2	0.0
125	6/03/82	21	71.8	61.9	.	53.7	313.3	1.7	0.0	270.8	0.8	0.8
126	6/03/82	22	73.0	62.9	62.4	53.1	328.3	1.7	4.2	355.0	4.2	2.5
127	6/03/82	23	71.9	62.6	62.1	54.6	340.8	1.7	0.0	339.1	2.5	2.5
128	6/03/82	24	72.2	63.3	62.6	55.0	314.2	1.7	1.7	358.3	0.8	1.7

APPENDIX VIII
RT. 444 - WILLOW STREET 1
BEFORE BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L1P2	NSL	NST	FSL	FST
1	3/30/78	1	76.9	73.5	68.0	196	0	257	2
2	3/30/78	3	77.5	73.6	67.6	244	0	192	0
3	3/30/78	6	77.5	73.6	.	219	0	193	0
4	3/30/78	8	77.6	73.9	.	275	0	234	0
5	3/30/78	10	77.6	73.8	.	220	0	199	1
6	3/30/78	13	76.9	74.0	.	235	0	226	0
7	3/30/78	14	77.0	74.2	68.2	242	0	219	2
8	3/30/78	15	76.9	73.8	67.9	229	0	211	0
9	3/30/78	18	78.5	75.5	69.4	285	0	244	0
10	3/30/78	20	77.4	74.2	67.9	248	0	231	0
11	3/30/78	21	77.5	74.6	68.5	245	1	247	1
12	4/03/78	44	78.0	76.3	69.9	166	2	216	0
13	4/03/78	46	77.9	76.4	69.9	174	1	193	1
14	4/03/78	50	.	76.7	69.7	191	0	186	2
15	4/03/78	51	77.9	77.1	70.1	181	0	202	1
16	4/03/78	52	77.7	76.3	.	179	0	188	1
17	4/03/78	54	77.2	75.5	.	178	0	222	0
18	4/03/78	56	78.2	77.3	.	207	0	208	0
19	4/03/78	57	76.1	75.2	.	121	0	226	0
20	4/03/78	58	76.4	74.6	.	111	0	239	0
21	4/05/78	61	76.4	74.3	67.6	210	0	169	1
22	4/05/78	63	76.1	73.9	67.1	204	1	191	0
23	4/05/78	64	76.2	74.7	67.8	206	0	187	1
24	4/05/78	65	76.8	74.5	67.7	239	0	188	0
25	4/05/78	67	77.1	74.8	68.1	230	1	198	0
26	4/05/78	68	76.1	74.1	67.0	204	1	176	1
27	4/05/78	70	.	.	67.3	184	1	211	0
28	4/05/78	72	.	.	66.2	171	1	223	0
29	4/05/78	73	.	.	67.4	215	1	213	0
30	4/26/78	75	77.6	77.6	69.6	217	0	196	0
31	4/26/78	76	77.3	76.2	69.4	199	1	205	1
32	4/26/78	78	77.6	76.3	69.3	216	2	199	1
33	4/26/78	79	77.5	76.5	69.4	206	3	189	2
34	4/26/78	80	77.8	75.7	69.4	241	3	174	0
35	4/26/78	84	77.5	76.1	69.2	211	3	169	1
36	4/26/78	86	77.5	77.5	69.6	262	2	221	1
37	4/26/78	92	78.4	77.9	70.1	263	5	262	0

APPENDIX IX
RT. 444 - WILLOW STREET 2
BEFORE BARRIER CONSTRUCTION

OBS	DATE	OBSNO	REF	L1P1	L1P2	NSL	NST	FSL	FST
1	4/14/78	2	75.0	70.4	57.4	239	0	212	2
2	4/14/78	4	74.5	69.8	56.4	193	2	177	1
3	4/14/78	5	.	.	56.0	239	0	222	1
4	4/14/78	7	.	.	56.0	228	0	230	1
5	4/14/78	8	.	.	57.2	239	2	230	1
6	4/14/78	9	.	.	57.0	281	1	223	3
7	4/14/78	10	.	.	58.2	247	1	176	2
8	4/14/78	11	77.1	71.4	59.7	255	1	247	0
9	4/17/78	20	76.7	.	.	185	0	175	1
10	4/17/78	21	77.5	73.9	65.0	146	0	192	0
11	4/17/78	28	.	.	66.9	247	0	270	0
12	4/17/78	29	.	.	66.7	241	0	240	0
13	4/18/78	30	76.9	71.6	65.1	223	1	186	1
14	4/18/78	32	76.4	71.7	65.2	176	1	190	1
15	4/18/78	35	76.9	73.6	66.4	208	0	194	1
16	4/18/78	36	76.8	73.4	.	190	1	170	1
17	4/18/78	37	76.7	73.4	66.5	169	1	171	2
18	4/18/78	38	77.1	71.4	66.5	185	0	165	0
19	4/18/78	41	76.5	70.5	.	207	3	210	1
20	4/18/78	42	76.8	73.6	66.2	215	1	189	0
21	4/18/78	45	76.8	74.2	66.2	210	0	205	3
22	4/18/78	46	77.5	74.5	67.0	221	0	233	3
23	4/18/78	51	77.8	74.8	67.0	250	5	225	0
24	4/18/78	52	76.8	74.5	66.0	208	1	247	0
25	4/18/78	53	77.6	74.8	67.1	237	0	246	0
26	4/21/78	60	.	.	63.9	241	0	268	3
27	4/21/78	64	.	.	64.4	244	1	297	1
28	4/21/78	66	.	.	64.8	249	0	269	2
29	4/24/78	70	76.5	71.0	63.7	220	1	193	1
30	4/24/78	71	76.2	70.7	63.7	215	1	215	1
31	4/24/78	74	75.4	70.1	63.0	196	0	204	0
32	4/24/78	75	76.0	71.2	63.5	207	2	221	1
33	4/24/78	77	76.1	70.9	63.7	221	1	199	1
34	4/24/78	79	.	.	62.0	269	2	220	1
35	4/24/78	81	.	.	63.6	224	1	217	2
36	4/24/78	82	.	.	63.3	209	0	203	0
37	4/24/78	85	.	.	64.0	232	2	232	0
38	4/24/78	88	.	.	64.1	196	2	234	0
39	4/25/78	91	76.9	70.7	63.4	223	3	190	2
40	4/25/78	98	76.4	70.5	63.6	212	4	172	2
41	4/25/78	99	75.9	70.8	63.4	154	0	194	0
42	4/25/78	100	76.6	71.2	63.9	199	3	181	1
43	4/25/78	108	.	72.5	64.9	212	1	177	3
44	4/25/78	117	78.7	72.1	65.3	188	0	218	1
45	4/25/78	118	.	.	65.2	228	2	211	4
46	4/25/78	127	.	.	65.5	219	0	241	4

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